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SUMMER.

SACRED PHILOSOPHY

OF THE

SEASONS.

SUMMER.

Edinburgh:
PUBLISHED BY WILLIAM OLIPHANT AND SON
1828.

SACRED PHILOSOPHY

OF THE

SEASONS;

ILLUSTRATING

THE PERFECTIONS OF GOD

IN THE

PHENOMENA OF THE YEAR.

467

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BY THE

REV. HENRY DUNCAN, D. D.

RUTHWELL.

SUMMER.

"Thou crownest the year with thy goodness, and thy paths drop fatness. They drop upon the pastures of the wilderness; and the little hills rejoice on every side. The pastures are clothed with flocks; the valleys also are covered with corn. They shout for joy; they also sing."

PSALM LXV.

SECOND EDITION.

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" Thou art, O God, the life and light
Of all this wondrous world we see ;—
Its glow by day, its smile by night,
Are but reflections caught from thee !
Where'er we turn, thy glories shine,
And all things fair and bright are thine.

* * * *

" When youthful spring around us breathes,
Thy spirit warms her fragrant sigh,
And every flower the summer wreathes,
Is born beneath that kindling eye :—
Where'er we turn, thy glories shine,
And all things fair and bright are thine."

MOORE.

EDINBURGH : W. OLIPHANT, JUN. AND CO. PRINTERS, 23, SOUTH BRIDGE.

ADVERTISEMENT.

In this Volume, the argument for the Divine perfections from the works of Nature, entered upon in the two preceding volumes of "Winter" and "Spring," is continued. Organized life has now passed, or is rapidly passing, from a state of development to a state of perfection; and, Winter having been considered as the period of gestation, and Spring as that of production, Summer is here viewed as the season of maturity. This is not, indeed, strictly true; for many of our fruits, and all the cereal plants, are, in our climate, still only in progress, and do not ripen till the autumnal months; while numbers of the animal tribes are, at present, but in the early stage of their existence;—and, in this respect, to man all seasons are alike. It is, however, the general character of the season that is to be considered; and classification is more important, in a work of this kind, than a strict attention to dates.

In this, as in the other volumes, I have commenced with a view of the various cosmical arrangements by which the season is distinguished and rendered salutary, and have thence passed to the consideration of vegetable life; and thence again to that of the va-

rious powers and functions of animal life,—keeping always in view the reference which every thing evidently bears to the only rational being whom it has pleased the Eternal to place in this lower world, or, at all events, to subject to the operation of the senses.

The Volume next contains some notices of Man himself, as regard his physical, intellectual, and moral powers; and closes with a summary of the argument which this analysis of Nature has exhibited, with special attention to the peculiar modifications of that system of providential administration, under which the Fall of our First Parents has placed terrestrial things.

In thus ranging through the whole bounds of creation, where the materials are so unlimited in their extent and variety, I have ever found it much more difficult to determine what might without prejudice to the argument be rejected, than what might be usefully chosen. All Nature, in its various kingdoms, in all its orders, in all its species, in every individual modification, proclaims the perfections of the Creator. In such superabundance, however, I have had the advantage of easily avoiding what was abstruse and recondite; while my object has been to select what was most interesting and most easily understood, as well as important, striking, and conclusive.

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SACRED PHILOSOPHY

OF THE

SEASONS.

SUMMER.

FIRST WEEK—SUNDAY.

SUMMER THE PERFECTION OF THE YEAR.

Summer is the manhood of the year. Its powers are developed; its vigour is fresh; its plans are matured; it is in the full flush of beauty, and buoyant with the joy and bustle of existence. Turn where we will there are proofs of operations begun and in progress, which indicate design, wisdom, and activity; of an infancy and youth spent in preparation, and ending in settled purposes reduced to practice, and useful employments industriously prosecuted.

Such is the general character of this season; and when we take a more accurate survey of particulars, a thousand delightful illustrations occur, all leading us to the same sublime conclusion, that the natural operations which are silently proceeding around us, are the work of a present Deity, and a reflection of his attributes. In the sacred poetry of the Hebrews, we meet with many solemn and beautiful views, which show how much alive the inspired writers were to such impressions. The

hundred and fourth Psalm is an example of this; and a few passages from that majestic production may serve as an illustration. "He watereth the hills from his chambers, the earth is satisfied with the fruit of thy works. He causeth the grass to grow for the cattle, and herb for the service of man, that he may bring food out of the earth; and wine that maketh glad the heart of man; and oil to make his face to shine; and bread which strengtheneth man's heart. He appointeth the moon for seasons; the sun knoweth his going down. Thou makest darkness, and it is night; wherein all the beasts of the forest do creep forth. The young lions roar for their prey, and seek their meat from God. The sun ariseth, they gather themselves together, and lay themselves down in their dens. Man goeth forth unto his work, and to his labour, until the evening. These all wait upon thee, that thou mayest give them their meat in due season. That thou givest them they gather. Thou openest thine hand, they are filled with good: Thou hidest thy face, they are troubled: Thou takest away their breath, they die and return to their dust: Thou sendest forth thy spirit, they are created; and thou renewest the face of the earth. The glory of the Lord shall endure for ever. The Lord shall rejoice in his works."

To such reflections the pious mind is naturally led, in casting an eye over the luxuriant scenery which this season presents, and contemplating the various tribes of animated beings, for whose use such a profusion of bounties is scattered abroad. It requires no philosopher, deep-read in the mysteries of nature, to inform us that there is a profound and beautiful adjustment among all the departments of nature, in which the hand of an intelligent Creator is distinctly seen. The earth, the sea, the air, and the blue vault of heaven, with its orbs of light, all speak the same language. There is a harmony and an adaptation among these mighty elements, which strike the mind at first sight, and which are ex-

hibited more clearly by every subsequent inquiry. Were any one of them either wanting, or even materially altered, the system would be destroyed. And while they harmonize among themselves, they are peculiarly distinguished by their adaptation to the support of organized existences. Without the sun, the earth would be a dark and useless mass; without the sea, there would be no moisture to support organic life; without the air, there would be no machinery for conveying that moisture to water the soil; without any one of these there would be no vegetation,—no animals,—nothing but desolation, silence, and death. That these inorganic powers might exist independent of an intelligent Cause, might be admitted, although any reasoning which should demand such a concession, could only be founded on an appeal to our ignorance; but that they should exist in such proportions and combinations as to produce the phenomena of nature, may be safely pronounced impossible.

It is now our peculiar business, however, to consider these matters only in so far as they relate to the present season of the year. The contrivances connected with Winter and Spring, have already been traced; and, in considering them, we have had occasion continually to exclaim, in the language of the psalm from which we have quoted:—"O Lord, how manifold are thy works! In wisdom hast thou made them all; the earth is full of thy riches." The very same character will be found impressed with equal distinctness on the appearances and operations of Summer.

There is a pleasure peculiar to Spring in the contemplation of Nature rising, as it were, from the tomb, and bursting into life, and light, and joy; but that which belongs to Summer is not less intense, although of a different kind. The delight of this season arises from the view of the full development or successful progress of the powers and processes which in Spring began to operate. The plants, which had just pierced the earth in the commencement of that season, have now shot forth

their stalks, and expanded their blades, and opened their beautiful flowers to the sun; the trees rejoice in their leafy pride; the fields luxuriate in the abundance of their vegetable stores; and animated nature is instinct with life and enjoyment. The whole scene is full of delight; but it is only when it is associated with religious feelings, and when it raises the mind to a Father Being, who called all this loveliness into existence, and whose unseen presence and mysterious energies cheer and bless the world He has made, that it can be enjoyed with its highest and most appropriate relish. It is this pious sentiment which gives such sublime beauty to the "Hymn on the Seasons;" and perhaps there is no part of that hymn which more successfully expresses the tenderness and devout admiration of a rightly constituted mind, in contemplating the wonders of Nature, than that which refers to Summer:—

"Then comes thy beauty in the summer months
With light and heat refulgent.—Then thy sun
Shoots full perfection through the swelling year;
And oft thy voice in dreadful thunder speaks;
And oft, at dawn, deep noon, or falling eve,
By brooks and groves, and hollow whispering gales.
* * * * *
Soft roll your incense, herbs, and fruits, and flowers,
In mingled clouds to Him, whose sun exalts,
Whose breath perfumes you, and whose pencil paints."

There is an analogy between the world of nature and the world of grace. In the latter, as well as in the former, there is a spring and a summer,—an infancy and a manhood. The first breathings of Divine love on the heart are often faint and fitful. They come like the first breeze of spring, fraught with warmth, and bearing the promise of future fruit, but passing over a dead and barren region, to which they seem unallied and uncongenial. They are generally succeeded by wintry gloom and tempest, which, from contrast and disappointed hope,

they render only more dismal. But still gentler breezes breathe, and longer light and a warmer sun shed their genial influences, till the whole soul glows and is renewed, and the germs of a Divine nature, springing into life, reveal the creative power of the Spirit which erewhile moved on the face of the deep, and gave order and beauty to the formless void of the material world. The work proceeds amidst alternate sunshine and showers; the warmth and illumination increase; the virtues and graces grow and expand; what was wavering becomes steady; what was feeble becomes strong; what was sterile luxuriant; the dark brightens; the deformed is clothed with beauty; where there was deadness, there is animation; where there was taint and corruption, there is health and soundness. The spring is past, and summer reigns. The Sun of Righteousness shines in all his glory, and the soul is buoyant with spiritual life, and teems with fruit.

Yet this progress, though sure, is slow, and frequently retarded. The sun is not yet without clouds, nor the atmosphere free from storms; a sudden cold may still chill; the thunder may raise its terrible voice; the floods may burst forth and overwhelm. The enemy comes: Tares are sown and grow; thorns spring up, and mildew and blight are in the air. It is, at the best, but an earthly summer, though the vivifying influences come from heaven. The harvest, however, approaches. Then the tares shall be separated from the wheat. The tares shall be burned with unquenchable fire; but the wheat shall be gathered into the garner of God.

FIRST WEEK—MONDAY.

INCREASED HEAT.

Summer may be said to be the season of growth, as Spring is of reproduction. Those organized existences,

which burst into life in the latter season, are either brought to maturity, or, at least, invigorated and expanded in the former, and, in both seasons, the peculiar character of the weather is most wisely adapted for the intended object. We have already had occasion to remark the proofs of Creative design and intelligence, which may be drawn from the adjustment that subsists between the inorganic and the organic worlds, in very many and very striking particulars. The state of the atmosphere, during the progress of the summer months, presents itself as an appropriate subject of consideration, in entering on the study of this season.

I have elsewhere stated the general principles of atmospheric phenomena,* but what falls under our notice at present, is the change produced in the weather by the advancing year. The sun is now approaching the northern tropic, having, in the month of March, passed from the south to the north of the equator. He is rising high in the heavens, and thus pouring his rays more directly on this part of the earth, which, according to a principle already explained, causes his influence to be more powerful; and what much adds to this influence, is the greater length of time in which he remains above the horizon. In the depth of winter, we enjoyed his presence little more than seven hours out of the twenty-four. In the beginning of summer, this period is increased to upwards of fifteen hours, and in the middle of it he daily lingers with us two hours longer still. There is thus not only a great direct increase, but a great accumulation of heat. The mode in which this effect is produced, may be shortly mentioned. The rays of the sun, or whatever the influence may be which generates heat, in passing through a perfectly transparent medium, do not increase the temperature of that medium. They seem to require resistance to produce this effect. It is not therefore till

* Volume on "Winter," article Atmosphere, &c.; and volume on "Spring," article Rain, &c.

they reach the earth, that their power is very sensibly exerted. In striking upon the opaque surface of our globe, they give out their qualities. Light and warmth are produced and reflected. The earth and the atmosphere are thus both subjected to their influence. These become heated, the one by conduction, the other by reflection. Now, it is obvious, that while the intensity must be in proportion to the directness with which the globe is struck by the sun's rays, the accumulation must be in proportion to the length of time during which the influence continues. Hence, there is a double cause for the summer's heat, the height to which the luminary rises in the heavens, and the length of the day compared with the night. These causes operate in an increasing ratio. Day after day the accumulated heat receives fresh accessions. Every time the sun's influence is repeated, it penetrates deeper below the surface, and is more intensely reflected into the already heated atmosphere. This effect continues even after the direct solar heat has begun to be diminished; and it is not till several weeks after the sun has begun to take a retrogade motion, that the temperature is at its maximum. In June, the sun reaches his greatest height, and begins to decline, but the heat continues to increase till the middle or end of July.

But there are various circumstances besides warmth, which constitute summer weather. The mechanism of the atmosphere is very complicated, and the adjustments which it requires are exceedingly nice, and considering merely the nature of the powers employed, we may well add, hazardous. Any change in the relative proportion of one of the principles, is calculated to produce a powerful effect on all the rest, and were there not a regulating power of consummate wisdom, it might be expected that the balance would be overset, and that the most disastrous consequences would ensue. Let us look for a moment at the constituents of the atmosphere, and this will become apparent. The air, which forms the chief

part of the atmosphere, is composed of two substances, held together merely by mechanical admixture, which are of very different properties, and which require to continue united in the precise proportion they actually bear to each other, in order to be capable of sustaining animal and vegetable life. Were that proportion destroyed even in a slight degree, the air we breathe would be instantly converted into a deadly poison. Now, it is well worthy of remark, that, although in the functions both of animal and vegetable life, and in the process of combustion, a great and apparently unequal consumption of these two substances takes place, the proportion between them is always maintained, and that notwithstanding any difference of temperature. Heat expands, and cold contracts them, but they are not thus disunited, or in any way disturbed in their proportions. On the contrary, it is probably in some degree owing to the alternations of heat and cold, which keep up a constant motion in this wonderful fluid, that the necessary balance is maintained.

Another ingredient in the atmosphere is moisture. This is very sensibly acted on by heat. It is the principle of heat which evaporates the moisture from the earth, and causes it to mix with the air, and to float in it, sometimes as an invisible fluid, sometimes in the form of clouds, and which at other times causes it to be precipitated in the form of rain. Now, the remarkable circumstance is, that although heat is the agent in these operations, the change of temperature does not so affect the process as to cause the operations to cease, or very materially to disturb them. Evaporation goes on both at a low and a high temperature, and in both states clouds are formed and rain falls. This is owing to a very peculiar provision, obviously imposed by consummate wisdom. The air is made capable of containing vapour in a certain proportion to its temperature, and it is not till it be saturated that the evaporation from the surface of water ceases, or that deposition takes place. The tem-

perature of the air in winter does not indeed admit of the same quantity, being held in solution, as in summer, but up to a certain point it is equally capable of sustaining it in the one case as in the other. Evaporation, therefore, takes place in very cold weather, even from ice and snow, and the water thus infused into the air is carried up into the higher regions, till it reaches the point where the temperature is such as to correspond with the quantity of moisture. Precisely the same process takes place in summer, with this difference, that the evaporation is much more abundant, and the air, owing to its increased temperature, is capable of containing a far greater quantity in solution. Again, the point of deposition is regulated by a similar law, with a similar difference. Deposition does not take place either in winter or summer, till the air is more than saturated; but this effect is produced at very different temperatures, according to the quantity actually held in solution, so that a very slight degree of cold will form clouds and cause rain in summer, compared with what is necessary to occasion the same phenomena in winter. Hence the processes of evaporation and deposition are made, by this very peculiar law, always to bear a relation to the actual temperature of the season, and such a balance is kept up between these processes, as is admirably suited to the wants of vegetable and animal life.

I may add to all this the properties of the atmosphere, by means of which it is made the vehicle of light and sound, and the means of respiration. The changes which the air undergoes by the operation of heat and cold, might easily be supposed, and might even perhaps, reasoning without the aid of experience, be expected to produce a material alteration on such properties. But although these changes are so considerable in different seasons, and in different climates, we do not find that the laws either of vision or of acoustics, are in any material degree affected by them,—or that the action of the

lungs either in man or the lower animals is impeded or deranged.

In attending to the complicated nature of the atmosphere, and the various important functions it has to perform, and in considering the diversified modifications it must necessarily undergo by the alteration of its temperature, both in the various latitudes of the globe, and in the different seasons of the year, it does seem impossible to doubt that the uniformity of its properties, and of its salutary influences under all these modifications, has been provided for, by what Whewell, considering that subject in a more extended view, justly calls "a most refined, far-seeing, and far-ruling contrivance." So many opposing forces, and the mingling of such subtle and fearfully active elements, appear in the most quiescent state to require amazing prospective skill for their regulation and control; and when we find them, even under the influence of extensive changes, still harmoniously combining their powers for the general good, we cannot but perceive that all this could not be effected but by the same paternal Hand which originally called their powers into action.

FIRST WEEK—TUESDAY.

INTERNAL HEAT OF THE EARTH.*

Besides the phenomena already alluded to, relative to heat, there is another of very extensive operation, which although it cannot be considered as entering immediately in any perceptible degree, into the formation of climate, is yet too remarkable to be passed over without some notice. I allude to the existence of that heat in the interior of our globe, which cannot be referred to external causes,

* For several of the facts stated in this paper, I am indebted to a valued friend.

and which has produced, and is continually producing, great and important changes on its surface.*

Indications of the action of a powerful heat in the inner strata of the earth, meet the geologist at every step of his investigation, and it is only by this agency that he is able to account for various existing phenomena at or near the surface, from which, instead of stopping to enumerate them all, I shall select a few of the most striking instances.

Two kinds of springs exist in Nature,—the common, and the thermal or warm. The temperature of the common spring is found to be nearly that of the medium temperature of the locality where it rises; the thermal spring possesses a considerably higher degree of heat. The temperature of the former is derived from the soil heated by the sun;—of the latter, from the warmth of those internal strata, from whence they issue. The thermal springs vary in their temperature from a single degree above the medium of the climate, to the heat of the warm waters of Bath, and the boiling Gysers of Iceland. These springs are to be found in almost every country, and exist to an extent which has not yet been ascertained. Artesian wells are almost universally thermal; and it is a strong proof of the existence of a high temperature in the interior of the earth, that the heat of these wells increases in proportion to the depths at which

* "The evidence in proof of great and frequent movements of the land itself, both by protrusion and subsidence, and of the connexion of these movements with the operations of volcanoes, is so various and so strong, derived from so many quarters on the surface of the globe, and every day so much extended by recent inquiry, as almost to demonstrate that these have been the causes by which those great revolutions were effected; and that, although the action of the inward forces which protrude the land has varied greatly in different countries, and at different periods, they are now, and ever have been, incessantly at work in operating present changes, and preparing the way for future alteration in the exterior of the globe."—*Fitton's Geological Sketch*: See also, *Lyell's Geology*, vol. i. *passim*. This author observes, that the subsidence occasioned by volcanic agency, is somewhat greater than the elevation, and that the climate has been much affected indirectly by the changes thus produced in the relative position of sea and land.

they take their rise,—a fact which seems to be ascertained on satisfactory evidence. It is also worthy of remark, that thermal springs do not belong exclusively to any particular formation, being found in the latest as well as in the oldest series. They exist below the level of the sea, and at all heights above it, to the extent of 12,000 and even 13,000 feet. They are discovered in all latitudes,—in the neighbourhood of the Polar Regions, as in Iceland and Greenland, equally as in the temperate zone, and under the equator. Their heat cannot, therefore, be sought for in any particular formation of rocks, nor in local chemical processes, but in some cause which is of very extensive operation throughout the interior of the earth.*

In connexion with the fact, that the temperature of Artesian wells indicates the depth of their formation, I have to observe, that, in all mines, it has been lately ascertained, that the temperature increases as we descend. The exact proportion of increase for the descent, has not yet been very accurately settled; but, by collating the observations already made, it may be safely stated at 1° of heat for every 45 feet of descent.

The last and most decisive proof of the existence of internal heat, is to be found in the volcanic agency, which appears in every age to have been actively and extensively employed, and so many traces of which have been left in every part of the world. Mr Lyell informs us, that there are certain very extensive regions, to which both volcanoes and earthquakes seem chiefly to be confined, and which would appear to be connected with immense internal fissures in the crust of the earth, through which the central heat finds its way to the surface. He particularizes the whole region of the Andes, including Mexico and the West Indies, which pursues a course of several thousand miles, from north to south; the region, of at least equal extent, which commences on the north with the Aleutian Isles, and extends first in an easterly

* Bischof.

direction, for nearly 200 geographical miles, and then southward, without interruption, throughout a space of between 60° and 70° of latitude to the Molluccas, where it branches off in different directions;—and, in the Old World, the region extending from the Caspian Sea to the Azores,—a distance of about 1000 geographical miles. "Over the whole of the vast tracks alluded to," says this author, "active volcanic vents are distributed at intervals, and most commonly arranged in a linear direction. Throughout the intermediate spaces, there is abundant evidence that the subterranean fire is at work continuously, for the ground is convulsed, from time to time, with earthquakes; gaseous vapours, especially carbonic acid gas, are disengaged plentifully from the soil; springs often issue at a very high temperature, and their waters are very commonly impregnated with the same mineral matters, which are discharged by volcanoes during eruptions."*

The fact, then, seems to be established, that there is a vast region of excessive heat in the centre of the earth; and that the crust of the globe is rent internally into very extensive fissures, along which that formidable agent approaches nearer the surface, and through which it finds occasional or permanent vents. This, being proved, seems to open to us, not only one of the natural causes of the previous revolutions on the surface of our planet, but a source of future disruption and ruin. The "more sure word of prophecy" informs us, that the time will come when the elements shall be dissolved with fervent heat, and the earth, and all that is therein, shall be burned up; and it is satisfactory to observe, that geological indications render this catastrophe not only possible, but probable. Let it only be conceived that the safety-valves, by which the superabundant heat generated internally is at present thrown off, were by some convulsion to be stopped up, or that some other deranging cause were to occur, which should destroy the equili-

* Lyell's Geology, vol. i. p. 360, &c.

brium at present subsisting between the great central fire and the shell in which it is enclosed, and an explosion would take place like the bursting of a bomb; or, at all events, a force would be exerted, which might altogether derange the present system of things, and set the world in a blaze. The powers which sustain the great planetary system, are equally balanced, and, notwithstanding the existence of a resisting medium, may, as to all practical results, be considered stable; but it is not so with the materials of our own globe. These have already undergone numerous disruptions; and there is one other catastrophe still in reserve for them. We see the elements of that catastrophe in existing phenomena, and, when we look to the announcements of Scripture, the event, which might almost be anticipated, is authoritatively foretold.

The friend who was so obliging as to furnish several of the above-mentioned facts, takes much laudable pains in the paper he has sent me, to show that the operation of natural causes in no respect precludes the immediate arrangements of the supreme moral Governor, in carrying on the great schemes of his providence; and that, even if it could be proved that the deluge, for example, or the destruction of the Cities of the Plain, was brought about in the natural course of events, these ought still to be regarded as catastrophes determined in the councils of the Most High, to bring signal vengeance on his rebellious creatures, and calculated by Him with consummate wisdom and unerring prescience, to effect a great moral purpose. Nothing can be more true or important than this sentiment. The world of Nature, and the world of Providence, are always in harmony; and the Eternal brings about his decrees usually by the adjustment of general laws, to the purposes of his moral government; —and yet He has reserved to himself the power of interfering with those laws when he thinks fit, that by doing what He alone could perform, He might bear undeniable testimony to the mission of his Son, or to those

messages which He was from time to time pleased to send by his servants from the unseen world. In the latter case, the hand of God is discovered by the miraculous nature of the transaction; in the former, by the fulfilment of prophecy. If the destruction of the world by fire, therefore, shall prove to be the result of natural causes, this will not diminish the evidence of Divine agency; for, independent of the miraculous events with which we are assured it will be accompanied, its very coincidence with prophetical intimations will sufficiently evince the source from whence it proceeds.

FIRST WEEK—WEDNESDAY.

INCREASED LIGHT.

It is not merely the increase of heat, but the increase of light, which constitutes the peculiarity of summer weather. The latter property is almost as necessary to organized life as the former, and its abundance at this season produces, doubtless, an important effect both on the vegetable and animal world. In another volume, I have alluded to the uses of light in the growth of plants,* and have particularly noticed the power which it possesses of endowing them with smell, colour, and inflammability, as well as the essential function which it exercises in respiration through the leaves, where the proper juice is secreted. Now, it is obvious that a very important effect must be produced in these particulars, by the degree in which light is communicated to them, both as regards its intensity and its duration. As long as the plant is in the light, the leaf decomposes carbonic acid, appropriating the carbon to the formation of its own proper juice, and returning the disengaged oxygen into the atmosphere. When light is removed, it has no longer power to imbibe carbon and disengage oxygen; but, on

* Spring, pp. 63 and 73.

the contrary, it gives back some of the carbon already obtained, and absorbs oxygen, for the purpose of reconverting this into carbonic acid. The simple mention of this fact shows in what a different state a plant must be placed with regard to its vegetative action, in consequence of the increased and lengthened light of summer. When the nights are longer than the days, the greater part of its existence is spent in reversing the process by which some of its most important properties are obtained. As the day lengthens, it requires longer time to feed on the light, and spends less in the exhausting, but still, to a certain extent, useful process of depletion.

In the increased light, then, as well as in the increased heat of the summer months, we find a beautiful adaptation to the peculiar properties of vegetable productions. They are now in a state of growth. In their progress towards maturity, they stand peculiarly in need of powerful excitement and healthy nourishment. This, the Creator has provided for them, not merely in the additional warmth, but in the additional brilliancy, and lengthened influence, of the solar rays. The beneficial effect thus produced will appear, whether we consider the different influence of different seasons in the same country, or compare the vegetation in one climate with that of another. In a gloomy season, when the light of the sun has been much obscured by clouds, this circumstance is not compensated for by the heat of the weather. Vegetable nature puts on a sombre hue, corresponding with the aspect of the atmosphere. All nature seems to droop. The flowers become pale, and hang their heads. Their fragrance and their beauty decay. The fruits ripen slowly and imperfectly, and their flavour comes not. Herbs, plants, and trees, seem all equally to mourn the absent sun. But let the case be reversed; let the clouds disperse, and the sun shine forth in his strength. Presently all nature regains its loveliness. The colours of the flowers brighten, and their perfume fills the air. The fruit blushes on the trees, and seems to invite the

hand of the passer by. The productions of the gardens and the fields are invigorated, and their peculiar properties are heightened and improved. Every thing seems to revive and to rejoice in the genial beam.

The powerful effect of light is not less obvious within the tropics, and in countries bordering on these regions. There the beauty and fragrant scent of the flowers increase in proportion to the brilliancy and clearness of the atmosphere; the taste of edible substances becomes more racy and pungent; and the vegetable produce increases in variety and usefulness. It is on the properties of light, more than on those of heat, that these differences depend, as has been proved by direct experiment.

Here, then, we have a new proof of beneficent contrivance. The source of heat is also the source of light. These two qualities, though differing from each other in essential properties, are yet combined in the sun, and constantly accompany each other by means of this combination, in all the arrangements which constitute weather, becoming more or less intense in relative proportions. We are so accustomed to find light and heat in combination, that it seems to be a kind of violence done to our judgment, to consider them as disunited. They are probably, indeed, properties of the same substance, although one set of these properties is sometimes quiescent, as we have elsewhere observed,* while the other is in a state of activity. Let us suppose that they always appeared separately; that the sun, for example, was the source of heat, and the moon the source of light. The earth would still be cheered, every twenty-four hours, with the presence of both of these essential qualities, but without correspondence, and without co-operation. The moment that they ceased to coincide, they would cease to be useful. The whole system of the weather, and along with it, of organized matter, would be deranged; vegetable life would cease to be reproduced; and this being the case, animal life would ne-

* See "Winter," articles on Ignis Fatuus, Phosphorescence, &c.

cessarily perish. A much smaller alteration than this, indeed, would produce nearly a similar effect. Suppose that the law were, that light and heat should give out their influence in an inverse, instead of a direct ratio,—that the light was greatest when the heat was most diminished. We should thus have brilliant, but cold suns in winter, and warmth but gloom in summer. The consequences of such an arrangement it might be difficult to trace in all its effects on the complicated machinery of the atmosphere; but that it would be altogether unsalutary, it is easy to perceive. The heat of summer might be sufficient to cherish a pale and feeble vegetation, but the plants would be destitute of a vigorous fibre, the flowers would but languidly expand their petals, and the seeds would not ripen. In a few years, on the supposition of the constitution of plants remaining the same as at present, the powers of reproduction in most of the vegetable kingdoms would cease, and the soil would be left in possession of the few unimportant plants which now flourish in the shade.

There appears to be nothing in the nature of things to render such an arrangement impossible. How comes it, then, that light and heat increase and diminish in the same ratio, or, indeed, that they are combined at all? Or, granting that there is a natural necessity for this combination, how comes it that plants have received such a constitution that the increase of light is as necessary to their perfection as the increase of heat? Only one answer can be given to this question. It is the arrangement of an Intelligent Being. Chance is excluded. The law which connects vegetable life with the actual state of light and heat, must have been imposed by a wise and benevolent Creator.

If it be objected, that I have been speaking only of the properties of the sun in temperate regions, and that between the tropics a different law prevails; I answer, the arrangement is, in some respects, different, but not opposite. There is a smaller range in the alternations of heat

and cold, of brightness and gloom, of night and day; and let it be remarked, that both vegetables and animals are singularly adapted to this peculiar condition. Organized existences are created with properties suitable to the state of the tropical weather, just as others are created for existing and flourishing under the arrangements of a temperate climate: And this, in fact, singularly strengthens our argument. How does it happen that tropical plants possess these properties? It is not from an inherent principle of accommodation to circumstances; for plants possess the property of acclimation, as it is called, only within a very narrow range. Change the arrangement with what caution you may, and the experiment will not succeed. Convey the tropical vegetation to the temperate zone, and that of the temperate zone to the tropics, and no favourable circumstances can prevent them from becoming extinct, when left to the natural agency of the climate. Can this be the effect of chance? Can it be mere accident, that the one set of existences is suited to the one set of conditions, and the other to the other? The reply may be safely left to the common sense of the reader; and here again we have a new subject of devout admiration.

FIRST WEEK—THURSDAY.

ELECTRICITY.

The principle of electricity has been already mentioned as residing in the atmosphere; and as it frequently displays its tremendous powers during the summer months in the thunder stroke, it seems to demand some notice, although its properties have been more distinctly ascertained than its uses. The truth is, that notwithstanding the attention of philosophers has been very assiduously turned to this subject of late years, especially since the discoveries of Franklin and Galvani, and

many very singular facts have been established in regard to this remarkable agent, there is still so much obscurity attached to the whole subject, that, in the present state of the science, nothing very precise can be stated as to the important functions which it doubtless exercises in the economy of nature.

That electricity extensively pervades the fluid which surrounds our globe is certain; and it is not less distinctly ascertained that it performs a powerful part in influencing and modifying the changes which take place in the weather, both as relates to warmth and to moisture; but its substance is too subtle, and the laws by which it acts are too singular to enable us, in the present state of our knowledge, to decide either as to the exact nature or the full extent of its operations. That it is extensively employed in the various modifications which the clouds undergo, may well be believed, since it has been ascertained, by means of Franklin's electric kite, that clouds are sometimes negatively and sometimes positively electrified; and, indeed, the copious falls of rain consequent on a thunder-storm, are themselves a sufficient proof of this influence. It has been supposed, that it is the electric power which preserves moisture in the form of mist or cloud while floating in a state of deposition, and that when this influence is withdrawn, it necessarily falls in the form of rain. If this be the case, as is probable, an agency is assigned to the principle which is both extensive and highly important. Were rain always to be the consequence of the deposition of moisture in the atmosphere, a totally different, and certainly a less salutary result would be produced. There would be no clouds, and the showers would fall, almost without warning,—suddenly, violently, and frequently. It is probable, too, that rain would fall more partially and unequally than is the case at present, when clouds, once formed, are borne in all directions on the wings of the wind. At all events, we know, that the present means, whatever it may be by which the distribution of

moisture on the surface of the earth takes place, is most skilfully adapted to the purposes of organic life.

Another property which has been said to belong to the principle of electricity, is the assistance which it affords to the processes of vegetation. While these processes proceed, it is ascertained by some late experiments, that there is a constant circulation of this fluid, if it deserves that name, between plants and the atmosphere, and there is, therefore, reason to believe, that this circulation is essential to the growth and health of the former. Various contradictory experiments, however, have been made on this subject, producing conflicting theories, and not ending in any very satisfactory result. The Abbé Nollet and the Abbé Bertholon, both made experiments, which seemed to prove that the artificial application of electricity considerably accelerated the vegetable process, and rendered it more vigorous; and the latter took so strong a view of this subject, that he seriously proposed the erection of what he named *electro-vegetometers*, or thunder rods, for bringing down the electricity of the atmosphere to the earth, for the purpose of fertilizing the soil. After describing his plans, he thus expresses himself:—"By these means we shall have an excellent vegetable manure, or nourishment, brought down, as it were, from heaven, and that, too, at so easy an expense; for, after the construction of this instrument, it will cost nothing to maintain it: it will be moreover, the most efficacious you can employ; no other substance being so active, penetrating, or conducive to the germination, growth, multiplication, or reproduction of vegetables." The Abbé's views, however, appear to be visionary; and the experience of several other philosophers are far from confirming the effects above mentioned, so that nothing more can be positively affirmed, from actual experiment, than the existence of a circulation of electricity in plants during vegetation. Further experiments are required to elucidate this very interesting subject.

It is now generally understood, that the phenomena of electricity depend on the existence of two fluids of different but corresponding qualities. Into this subject it scarcely lies within my province to enter; and all that is needful to be noticed is, that there is a negative and a positive electricity, each possessing peculiar laws, by whatever theory these laws may be accounted for. These agents, or properties, give rise to the remarkable natural phenomenon of thunder. This has been ascertained abundantly by direct experiment; and it may be held as proved, that the explosion takes place in consequence of a communication between two substances, of which the one is positively and the other negatively electrified. This chiefly happens in certain conditions of the clouds, when the equilibrium of the atmosphere has been disturbed. When different currents of air bring into contact two clouds differently electrified, the consequence is, that a sudden interchange of the electric principles takes place, which gives rise at once to the thunder-clap and the flash: a similar effect is produced by the electric or non-electric state of the earth, when the atmosphere is in an opposite state. The lightning, in this case, does not flash from cloud to cloud, but descends in a thunder-bolt to the earth, or issues from it in the form of a brilliant flame. Under any of these circumstances thunder is produced, but it is only when the interchange is with the ground that there is danger of fatal consequences to organized existences. There is another form which the electric matter frequently assumes in the fine evenings of summer. It is called sheet-lightning, and bursts generally from behind a dark cloud near the horizon, in a broad and vivid flash, never accompanied with the sound of an explosion. In all these instances the intention is, that the atmosphere shall be restored to a salubrious state, by carrying the fluid from places which are over-charged, to others which are deficient.

Although we do not know the precise relations be-

tween electricity and the other elements which constitute the atmosphere, yet, so far as we can penetrate, these relations are highly salutary, and those who best know the properties of each, will be most ready to acknowledge, that there must be some wise and wonderful adjustment,—some mysterious, but most necessary regulating principle, by which the one has been rendered compatible with the useful operation of all the rest. With regard to thunder in particular, the effects of which are sometimes so tremendous, it is useful to remember, that this striking phenomenon is the result of an effort of nature to recover itself, and restore the equilibrium of its constitution, and may therefore be compared to the crisis of a fever, and various other indications of the *vis medicatrix* in the animal frame. It is awful but beneficial. "The deep lowering gloom of the thunder-cloud," says Mr Whewell, "the overwhelming burst of the explosion, the flash from which the steadiest eye shrinks, and the irresistible arrow of the lightning, which no earthly substance can withstand, speak of something fearful, even independently of the personal danger which they may whisper. They convey, far more than any other appearance does, the idea of a superior and mighty power, manifesting displeasure and threatening punishment. Yet we find that this is not the language that they speak to the physical inquirer: he sees these formidable symptoms only as the means or the consequences of good. What office the thunder-bolt and the whirlwind may have in the *moral* world, we cannot here discuss: but certainly *he* must speculate as far beyond the limits of philosophy as of true piety, who pretends to have learnt that there their work has more of evil than of good. In the *natural* world, these apparently destructive agents, are, like all the other movements and appearances of the atmosphere, parts of a great scheme, of which every discoverable purpose is marked with beneficence as well as wisdom."*

* Whewell's Bridgewater Treatise, p. 112.

FIRST WEEK—FRIDAY.

CLOUDS.

An important part of the machinery of the atmosphere is the formation of clouds, and their condensation into rain. We have elsewhere noticed the immense and constant evaporation which takes place from the land and sea, and the great quantity of moisture which is, in consequence, at all times floating around and above us. This moisture is sometimes held in solution in the atmosphere, and then it remains invisible, or can only be observed by an undulating motion, apparent in warm and clear weather, near the surface of the earth, occasioned by the constant change in the density of the medium, as it rises in steam from the soil. But when the water mingled with the atmosphere, comes in contact with a stream of cold air, which reduces its temperature below the point of deposition, it is immediately condensed, and passes into the form of mist; and this mist, when produced at some distance above the ground, takes the appearance of a cloud. As soon as a cloud is formed, its increased specific gravity will cause in it a tendency to descend; but, as it falls, it will probably pass into a warmer region, where it will again be evaporated, and pour its mixture upward till it once more reach a temperature sufficiently low to recondense it, when it will again begin to sink. This oscillation, however, will cease to take place in circumstances where the temperature and moisture are so balanced, that the evaporating process is on the point of commencing, or rather has actually begun; and the situation where this condition occurs, is generally found to be between two or three miles above the surface of the earth. Here, if a further reduction of temperature suddenly or extensively take place, assisted by the influence of electricity, more copious drops are produced, and the cloud, condensed into rain, falls in that form to the ground.

The changes I have mentioned are doubtless greatly promoted by opposite currents of wind, which, coming in contact with each other, when of different temperature, and therefore differently charged with humidity, destroy the equilibrium, and produce rain. These currents, again, are produced chiefly by an unequal distribution of heat, which causes one column of air to ascend, on account of its superior lightness, and another to take a downward course, on account of its gravity. It is thus that an interchange of air is constantly taking place between the equator and the poles. This disturbance has an extensive influence; because, when any considerable portion of the air is removed, the surrounding atmosphere must rush in to fill the vacant place, and thus currents are formed in all directions; while these, again, in their passage, producing condensation or evaporation of moisture, as has been said, by that very process, alter the equilibrium of the air, and increase or diminish the force of the wind. There is thus a very complicated operation continually going on in the atmosphere, which forms the machinery of the weather.

The circumstance to which we have at present to attend, is the formation of clouds; and I have to state, with regard to this subject, that there is here, as in every other atmospherical arrangement, abundant proof of providential superintendence. There are, indeed, so many and such powerful agents in operation, in constant opposition or combination, that it may be difficult, if not impossible, to trace the law by which the effect is produced; but that the alternations of clouds and sunshine, of moisture and drought, taken at an average, are salutary to vegetation, no person need be informed.*

* "In the midst of all this apparent confusion, however," says Mr Whewell, after enumerating the effects produced by the different laws regulating air and evaporated moisture, "we can see much that we can understand; and, among other things, we may notice some of the consequences of the difference of the laws of temperature, followed by steam and by air in going upward. One important result is, that the atmosphere is much drier, near

Now, what is particularly worthy of notice, is the controlled and regulated nature of this arrangement. There is no reason that we can perceive, why the relations between moisture and heat might not have been different from what actually exists, and a very slight change in these relations would apparently be sufficient seriously to affect the welfare of plants and animals. Why are clouds formed at all? Or, being formed, why is the place assigned to them so high in the atmosphere? And, again, why is the sun not constantly obscured by clouds; and why are these clouds liable to be formed into rain, and to fall in such genial showers upon the earth? We well understand the *final cause* of all this. We perceive in these arrangements a remarkable suitableness of atmospheric influences to the nourishment and health of organized existences; but it seems impossible to maintain that there is any thing in the mere mechanical powers existing in the atmosphere, which, of themselves, and without a wise adaptation to each other, could tend to produce these salutary consequences. No one can say that thus it must necessarily have been. That it is so, therefore, implies benevolent design. The only account that can be given of such facts is, that an intelligent Creator has so modified and adjusted the powers which exist in the atmosphere, as to fit them for the uses to which they are applied.

Nor must we forget, that while the existence of clouds, and the peculiar laws by which they are regulated, are

the surface, than it would have been, if the laws of density and temperature had been the same for both gases. If this had been so, the air would always have been saturated with vapour. It would have contained as much as the existing temperature could support, and the slightest cooling of any object would have covered it with a watery film like dew. As it is, the air contains much less than its full quantity of vapour. We may often cool an object ten, twenty, or thirty degrees, without obtaining a deposition of water upon it, or reaching the dew-point, as it is called. To have had such a dripping state of the atmosphere as the former arrangement would have produced, would have been inconvenient, and, so far as we can judge, unsuited to vegetables, as well as animals. No evaporation from the surface of either, could have taken place under such conditions."—*Whewell's Bridgewater Treatise*, pp. 104, 105.

beautifully adapted to the heat and light, so as to conspire with these agents in promoting the growth and perfection of the organized world, they also form appearances exceedingly grateful to the taste which the Creator has implanted in his rational offspring, and conducive to enjoyment. The vicissitudes of sunshine and shade, which the formation and dispersion of clouds produce, form an agreeable variety. The lights and shadows cast over a landscape, by the operation of this cause, are frequently productive of much pleasure, from the effects of contrast and of harmony in the scenery. Whether the sun bursts in his glory from a cloud, or casts a modest veil over a neighbouring slope, or rests calmly on the distant hills, or drives fleeting shadows across the fields and meadows, while a pleasing warmth pervades the softened air, and mingled sounds of industry and enjoyment are heard on every side, the mind experiences a delightful emotion, which cannot easily be defined, but is obviously derived from the constitution bestowed upon us by a benevolent Creator.

Nor, when we look from the earth to the sky, do we find less reason for acknowledging that a paternal attention has been paid to the gratification of our feelings. The clouds are made to assume a variety of shapes and shades, sometimes beautiful, sometimes sublime, almost always interesting and agreeable, especially during the summer months. The delicate tints which streak the morning sky, when the sun shoots his earliest beams from beneath the horizon, and seems to "rejoice as a bridegroom to run his race,"—the fervid glow which is shed over the heavens, when he "looks in his beauty from the clouds, and laughs at the storm;"—and especially the magnificence with which he sinks to rest, while the clouds, which calmly await his departure, resting on the verge of the horizon, appear to be clothed in their gorgeous drapery of gold, scarlet, and purple, in honour of the retiring monarch,—all these appearances are undoubtedly calculated, it cannot be too much to say *in-*

tended, to fill the heart of the spectator with admiration and delight.

These feelings, when associated with religious sentiments, become exalted and refined. The man who has been accustomed to see God in every thing, receives from all his blessings a satisfaction peculiar to himself; but the pleasure which he derives from objects of taste are especially affected by this principle. He owns them as a direct emanation from a Father's love; he feels a present deity; and, while his heart expands with a sense of the beautiful, and sympathizes with sounds, and sights of enjoyment, he rises beyond the boundaries of earth, to the infinite and self-existent Creator, and expatiates on the perfections of Him who is the source of all beauty and all happiness.

FIRST WEEK—SATURDAY.

DEW.

All have been struck with the beautiful phenomenon of dew, and must have had frequent occasion to observe its beneficial effects. A single dew-drop, so beautifully pure and clear, and so lustrous in the morning sunshine, is an object well worthy our attention and admiration. And when we see the fields and lawns, with their innumerable plants, strewn with "orient pearl," and sweetly refreshed by the copious moisture, so as to be prepared for the scorching heat of day, can we fail to be delighted by the beauty of the scene, and profoundly impressed by the inimitable skill with which all vegetation is thus watered and revived?

If we inquire into the causes of dew, and the periods of its more abundant formation, we shall find the same marks of Creative skill and benevolence that meet us in every other field of physical research. These causes may be very briefly stated. In all substances heat ex-

ists in a greater or less quantity; and from these it *radiates* in all directions, like light from a luminous body. Thus there is a constant and mutual interchange of heat between all kinds of bodies on the earth's surface, and, consequently, a tendency to a universal equalization of temperature. Heat is also given off from bodies by conduction; but conduction, strictly speaking, is only a particular, though a very remarkable, case of radiation. The process of conduction, moreover, is much less general and important than of direct radiation, which, in the great operations of Nature, is the chief means of transmitting heat from one substance to another. A great portion of the solar heat absorbed by the earth in the course of the day, is radiated into the cooled air during the night; and the radiation proceeds till the surface of the ground is at a lower temperature than the surrounding atmosphere, provided only the sky be serene. If the sky be cloudy, most of the radiated heat is re-transmitted from the clouds to the earth, so that the temperatures of the earth and atmosphere remain nearly equal. When the heat is not radiated back, but allowed to escape into the higher regions of the atmosphere, and the exposed surface of the earth, and of the substances upon it, thereby becomes colder than the air, it results from the principle of the condensation of vapour by cold, that a deposition of the invisible moisture floating in the air takes place. This moisture generally exists in the greatest quantity when the heat of the sun is powerful and continued; and at nightfall it is ready to be condensed into visible globules by the relatively cold substances with which it everywhere comes in contact. These globules of condensed vapour form what is called dew, and should be carefully distinguished from the moisture which is formed into clouds, and which visibly descends in the shape of rain or fog. Thus, dew cannot properly be said to fall, as it has been erroneously supposed to do. It is merely caused by the condensation of moisture contained

in the air that is in contact with a cold substance; and its formation is strictly analogous to that of the moisture which appears on the inside of windows when the external air is suddenly chilled,—of that which appears on a cold stone or piece of metal when we breathe upon it,—or of that which is observed on a glass of cold spring water, in hot weather, or in a warm room.

It has been ascertained, by experiment, that dark coloured bodies radiate heat, and therefore cool, with greater rapidity than bodies of a light colour. A dark or green substance, if it be exposed to the night air, will be covered with dew, while substances of a brighter colour, in similar circumstances, will remain almost dry. If the surfaces of the latter be smooth or polished, their radiation will be still less perfect, and their dryness consequently greater. In our morning walks we frequently see the green grass and bushes plentifully bedewed, while the light materials of the road remain untouched. Here we perceive a new and beneficial effect of the prevailing colour of vegetables. Green is not only a lively and beautiful colour, and less hurtful to the eye, but green substances are among the best radiators of heat, and are therefore most liable to condense the moisture of the surrounding air. Thus the leaves of plants, which require a constant supply of moisture, being mostly of a green colour, are admirably fitted to procure it.

In warm and settled weather, when the hot day is succeeded by the calm clear night, dew is most abundant. Now, it is just then that it is also most necessary; for the heat of the sun, unmitigated by any cloudy screen, increases greatly the general evaporation, and there is no rain to compensate for the increased quantity of moisture of which plants are thereby deprived. In cloudy weather, when the solar heat is mitigated, and rain is more abundant, dew is less necessary to the health and nourishment of plants; and it is precisely such weather that is most unfavourable to its formation.

The clouds, as we have already seen, radiate back the heat transmitted from the earth, and thus prevent the temperature of the ground from sinking to the *dew-point*. Frequently, when a clear nocturnal sky is suddenly covered with clouds, the dew already formed is evaporated, as the temperature of the earth is increased by the counter-radiation from above. And, again, should the clouds clear away, and the sky become serene, dew immediately begins to form. Thus, there is not unfrequently an alternate formation and evaporation of dew in the course of the night, as the aspect of the sky fluctuates between clear and cloudy. In covered or shady spots, it has been observed that there is always the least dew. The shade or covering radiates back the heat, and thereby keeps up the temperature of the ground below. Thus, in the recesses of the wood, where, on account of the impervious shade, there is least evaporation during the day, little or no dew is formed upon the rank grass, which is otherwise well provided with moisture: so little superfluity of means is there in the works of Nature. In the production of any given effect there is an economy of resources which, while it greatly enhances to our apprehension the wisdom and skill of the Creator, is well fitted to teach us a useful moral lesson.

How beautiful is the dew on a calm summer morning! It freshens every thirsty plant, washes every delicate flower, and gives new lustre to its finest tints. It cools and refreshes the whole surface of the ground. And as soon as the sun's earliest beams shoot forth from the eastern horizon, its innumerable drops twinkle in the golden light, like a fallen shower of diamonds. As the sun ascends, they disappear before his beams, partly absorbed by the plants on which they lay, and partly evaporated by the increasing heat. At night the moisture that composed them may form new globules, and invigorate the vegetation of other fields. Thus, in every department of Nature, there is an endless series of move-

ments and transmutations. On the earth's surface all is activity and unceasing play; all is subservient to the supporting in life and beauty the animal and vegetable world. The watery particles, in particular, display the most useful volatility. They ascend into the air by evaporation; they thence fall in the shape of dew, mist, rain, or snow. They re-ascend, or, incorporated with the waters of rivers, visit the ocean. But even there they feel the solar influence, and again mount on high to visit the fields and mountains they watered before, or haply to bedew the plants of another hemisphere.

Thus, in the appearance and effects of dew, we find the beautiful conjoined with the useful. In its formation we discover the most exquisite contrivance; in the times and places of its appearance, the most striking adaptation to the economy of vegetables. Yet by no intricate or peculiar arrangements is it produced; it forms no exception to the simplicity of Nature. Its varied and beautiful phenomena are the result of but three general laws,—the radiation of heat, and the condensation of vapour by cold, combined with the moulding power of corpuscular attraction, which forms it into globules. Here, therefore, let us admire and adore that Divine wisdom which, by means the most simple, produces the most wonderful effects, and which is everywhere rendered subservient to the designs of an unbounded goodness. J. D.

SECOND WEEK—SUNDAY.

SCRIPTURAL ALLUSIONS TO THE DEW.

Most of the grand phenomena and aspects of Nature are mentioned in Scripture, and so applied as to teach or illustrate some important lesson. They are spoken of as declaring the glory of God in creation; they are employed to represent his dealings with the children of men. The snow, the hail, the thunder, and the storm, are appealed to as grandly showing forth his power and terrible majesty; the wind, "that bloweth where it listeth," the early and the latter rain, and the gently dropping dew, are used as appropriate images of the blessings continually showered down from on high, and especially of the influence of the Holy Spirit upon the soul. The Bible, designed to be an intelligible record of Divine instruction, abounds in imagery borrowed from material nature, and expressly adapted to arrest and charm the attention. It contains many beautiful allusions to the phenomena of dew, a few of which we propose making the subject of this day's paper.

The beneficial effects of dew, in reviving and refreshing the entire landscape, have already been adverted to. How frequently do we observe the aspect of the fields and woods improved by the dew of a single night. In the summer season, especially, when the solar heat is most intense, and when the luxuriant vegetation requires a constant and copious supply of moisture, an abundant formation of dew often seasonably refreshes the thirsty herbs, and saves them from the parching drought. In Eastern countries, like Judea, where the summer is fervid and long continued, and the evaporation excessive, dew is both more needed, and formed in much greater abundance, than in our more temperate climate. There it may be said to interpose between the

vegetable world and the scorching influence of a powerful and unclouded sun,—to be the hope and joy of the husbandman, the theme of his earnest prayer and heartfelt gratitude. Accordingly, the sacred writers speak of it as the choicest of blessings wherewith a land can be blessed; while the want of it is with them almost synonymous with a curse. Moses, blessing the land of Joseph, classes the dew among "the precious things of heaven;"* and David, in his lamentation over Saul and Jonathan, poetically invoking a curse upon the place where they fell, wishes no dew to descend upon the mountains of Gilboa. The Almighty himself, promising, by the mouth of one of his prophets, to bless his chosen people, says, "I will be as the dew unto Israel; he shall grow as the lily, and cast forth his roots as Lebanon."† Here the refreshing and fertilizing effects of dew beautifully represent the prosperity of the nation which God specially favours and protects. The dew is also employed, by the prophet Micah, to illustrate the influence of God's people in the midst of an evil world, where he says, that "the remnant of Jacob shall be in the midst of many people, as a dew from the Lord."‡ What emblem more expressive of that spiritual life, in some of its members which preserves a people from entire corruption and decay!

Another beautiful application of the dew in Scripture, is its being made to represent the influence of heavenly truth upon the soul. In the commencement of his sublime song, Moses employs these exquisite expressions:—"My doctrine shall drop as the rain, my speech shall distil as the dew; as the small rain upon the tender herb, and as the showers upon the grass."§ Similar passages might be quoted from the sacred writers, wherein, by a felicity of comparison that all must at once acknowledge, the word and ordinances of God are likened to the dew of the field. How strikingly the reviving effects of dew upon the parched and thirsty vegetation of the sun-

* Deut. xxxiii. 13.
† Hosea xiv. 5.
‡ Micah v. 7.
§ Deut. xxxii. 2.

scorched plain typify the moral and spiritual freshness diffused by the word preached in its purity, and received with faith and love. As the dew of a night will sometimes bring back beauty and bloom to unnumbered languishing plants and flowers, and spread a pleasant freshness over all the fields, so will some rich and powerful exposition of revealed truth, or some ordinance, dispensed with genuine fervour, not unfrequently enliven and wholly refresh a Christian congregation, or even spread a moral verdure over a large portion of the visible church. If the soul be stained in its intercourse with the world,—if, like the grass on the way-side, that is covered with dust, it contract impurity in the beaten paths of life, the word of God falls upon it with a refreshing influence, like the dews of night upon that grass, to wash it, and to wipe away all marks of contact with surrounding corruption. If it be scorched by the withering sun of persecution, and pine for spiritual nourishment and support, that same word bedews it with the sweetest influences, and affords it sustenance, in richness and salubrity like that of the heavenly manna itself.

But let us not forget that the word of God sheds a healing influence, only when it is rendered effectual by the Spirit of all truth. The Spirit worketh through the instrumentality of the word; silently, secretly, and powerfully worketh; falling gently, operating unseen, and diffusing refreshment around, like the balmy dews of night. Of the Spirit's agency the dew is, indeed, the finest and aptest illustration. As dew to the parched and drooping flower, so is the Spirit shed upon the Christian's soul; as the "dew of Hermon," or "the dew that descends upon the mountains of Zion," spreading freshness and beauty over the whole surface of the ground, so is the same Spirit poured out in rich abundance upon the Church, the spiritual Zion, in times of reviving and refreshing from the Lord.

As we spring from our couch, therefore, on the bright summer morning, and walk joyfully forth into the fra-

grant fields, to breathe the inspiring air, feast our eyes upon the glowing mixture of colours in which all nature is arrayed, and listen to the sweet and various music that ascends from every grove, let us not fail to derive a high spiritual lesson from the dew that is so thickly strewn upon the grass beneath our feet. Distilled in the silent night by the reciprocal influences of heaven and earth, it bathes and refreshes each blade and flower with its stainless moisture. Let us regard it as the chosen image of God's choicest blessing, the cleansing and sanctifying influence of his Spirit upon the heart of man.

J. D.

SECOND WEEK—MONDAY.

ADAPTATIONS OF THE FACULTIES OF LIVING BEINGS TO THE PROPERTIES OF LIGHT AND AIR.

The fluids which surround our globe, so remarkable and so diverse in their properties, have already been considered in various aspects and relations, both as respect themselves and organized existences. There are, however, some striking adaptations of the animal creation to these fluids, which have not yet been considered. Among these, the conformation of the organs of sight and hearing are particularly worthy of notice.

Light possesses very peculiar qualities. Its rays dart with inconceivable rapidity; they are of different properties, and are either reflected in all possible directions from the objects on which they strike, or absorbed by these objects, or otherwise they pass through them. Now, there is a very artificially formed instrument in living bodies, obviously and most beautifully adapted to these qualities. That instrument is the eye. I cannot stop to enter into a minute examination of this curious and complicated machine. This has already been done, very effectively, by Paley; and I must refer my readers to his ingenious comparison between the eye and the tele-

scope, as one of the most interesting and triumphant arguments for Designing Wisdom which can easily be conceived. I must, however, request the reader to observe, that without the eye, light would be of no use to living creatures. It is not the object of any of the other senses. It cannot be perceived either by touch, taste, smell, or hearing;—yet its properties are of essential importance to animal life. A *camera obscura** is therefore bestowed on living beings, consisting of a small hole or opening in an opaque substance, through which, by means of a transparent medium, the rays of light are transmitted,—a finely formed lens, which collects these rays, and concentrates them, and a sheet or retina on which they fall at the proper focal distance, creating an exceedingly minute, but most complete and accurate, representation of external objects. This combination, so obviously artificial, forms an optical instrument, at once complete of its kind, and differing in its construction from any thing else in organized nature. The contrivances which constitute the lens and the retina, are peculiarly striking. The former is constructed with a most perfect and minute attention to the laws of optics; the latter is a singular and beautiful piece of workmanship, being an exceedingly delicate network of nerves, curiously interwoven, and ending in a nerve, which makes its passage to the brain. Here the mechanism is lost: human ingenuity can trace it no farther; because it is here that the mysterious and inscrutable principle occurs, which connects mind with matter, and conveys ideas of material objects to the sentient and reasoning powers. But up to this point, the contrivance is distinct and admirable. There is a mutual adaptation between the eye and the properties of light, which clearly exhibits benevolent intention. The rays reflected from all surrounding objects, under the various modifications I have mentioned, are received into every eye that is turned to them, and

* The eye was adverted to, under this name, in "Winter," p. 114, Third Edition.

give rise, in the mind, to the various ideas of light and shade, of shape and colour, of distance and nearness, of beauty and deformity; and thus disclose many fields of useful knowledge, which would otherwise have been shut, and unfold sources of exquisite and varied enjoyment, which would otherwise have been excluded; while they afford a theatre of exertion, without which the necessaries of life could not have been procured, and almost all the varieties of animated existence must instantly have perished. "If this does not prove appropriation," says Paley, after taking a similar view, "I desire to know what would prove it."

The adaptations between the ear of animals and the air, are not less remarkable. We cannot so distinctly trace the uses of the various parts of the ear, as an instrument of sound, as we can trace those of the eye; but we can observe enough to discover, that they are no less complex and artificial; and, at all events, they equally answer the intended purpose. We are surrounded with an elastic and fluid medium, in which impulses create vibrations. These vibrations are scarcely perceptible, to any of the other senses, and, if they were, could be of very little utility; but the ear is bestowed, and is made capable of receiving such impressions from these vibrations, as are productive of the highest advantages. If any person will attend to the various uses of sound, he will at once perceive of what importance to animal existence is the possession of an organ, by which it is perceived. To the inferior animals, it is that which warns them of danger; which attracts them to each other; which assists them in procuring their natural food; which is the medium of expressing their desires or aversions, their satisfaction or anger, their terror, their distress, their joy, or their sense of safety. Perhaps it may sometimes be the means of even more extensive communications between individuals of the same species. To man, it serves all the purposes we have stated, and much more. Air can be "shaped into words," and convey articulate

sounds to the ear, which form a most wonderful and important system of mutual communication, and contribute, in an amazing degree, to the happiness and improvement of the human race. To form a proper estimate of the advantages derived from this source, perhaps the readiest way is to suppose, that there was no such faculty as that of hearing. We pity a deaf person, on account of the privations to which he is subject; yet he possesses many advantages, from living among those who are endowed with the gift of which he is deprived. Let it be imagined, that the faculty of hearing had been entirely denied to the animal creation; and how many sources of enjoyment and of improvement would have been withheld! The want of so useful a medium of communication, would throw an effectual barrier in the way of advancement in the arts and comforts of social life; would shut us out from all the enjoyments of melody, and from those thousand nameless sympathies communicated by the intonations of the human voice. A dumb world would be a world of barbarism. The rational powers would remain unexpanded, the stimulus to exertion would be wanting, and man would be reduced to a level with the brutes.

Now, it is on the wonderful adaptation between the ear and the external air, that the perception of sound depends, and especially that exquisite perception of the minute distinction of sounds, which constitutes the power of receiving communications by means of language. The delicacy of this adjustment will be seen by reflecting on the difference which would be produced by only a slight variation, either in the auditory organ or in the air. Some particular states of the atmosphere are better adapted for the transmission of sounds than others; and it is easy to suppose, that the relations of this element with the ear, might be so altered as to render the vibrations either too loud or too low for utility. If, for example, a man attempt to speak after inhaling hydrogen gas, his voice will scarcely be audible.

Again, the ear is not merely adapted to the intensity of the aerial vibrations which constitute sound, but to various other modifications. The power of perceiving the pitch of voice, or the difference between acute and grave,—the quality of sound, or that which distinguishes one voice or sound from another, as well as that which is most important of all, the power of perceiving articulate sounds,—all depend on the adjustment to which we have alluded. The familiar circumstance of one person possessing a musical ear, of which another is altogether destitute, may serve to illustrate these remarks.

In addition to all this, we have the organs of animals, fitted for uttering each its own appropriate sounds; by virtue of which the lion roars, the horse neighs, the cow lows, the sheep bleats, and the dog barks; and, above all, man is gifted with those wonders of voice, by which he is enabled to form for himself the complicated structure of language, and thus to give full expression to his inward sentiments and feelings.

Most assuredly whoever contemplates these finely and skilfully adjusted relations, with candour, cannot fail to recognize an intelligent Designer. When we are asked how it comes that the eye should be formed for light, and light for the eye; or how it happens that the ear and the organ of speech should be so conformed to each other, and to the surrounding fluid of air, and this fluid to them, that from these combinations such incalculable blessings should flow to living creatures, and especially to man, it seems altogether vain to attempt any other reply, than that this is the work of an all-wise and benevolent Creator. Let any man examine these questions, with what minuteness he pleases, and attempt, by whatever ingenuity he may legitimately exercise, to escape from this conclusion, and he will only be more powerfully compelled to acknowledge the hand of a wonder-working and paternal God.

The instance of the eye is particularly striking, be-

cause it is so remarkably artificial, or rather because it can be so directly compared with works of human art. It is, as we have said, a complete and most skilfully constructed optical instrument, and its comparison with the *camera obscura*, or the telescope, brings out so many points of resemblance, that it seems impossible to attribute contrivance to the one, and deny it to the other. But there is another sentiment, which such a comparison forcibly impresses on the mind. There are points of contrast, as well as of resemblance, and in all these the unspeakable superiority of the Divine Artificer is most conspicuous. The human instrument is but a feeble and imperfect imitation of that which has come from the hands of the Creator. In the latter, there are many things which art in vain attempts to imitate, the mechanical skill is so exquisite, and the adaptations so nice.—And then, with what waste of thought, with what laborious stretch of ingenuity, with what patient toil and pains is the human instrument constructed. Who will venture to compare with this the creative power of the Omnipotent?

SECOND WEEK—TUESDAY.

GROWTH OF VEGETABLES.

I HAVE, in a former volume, given an account of the first development of vegetable productions, and detailed the general principles of their organization, and of their vital powers.* What remains, as introductory to a sketch of the properties of individual plants, which arrive at maturity during the summer months, is to explain their mode of growth, and the various contrivances by which they are adapted to the climate, and localities in which they are found.

The first thing worthy of observation on this subject,

* "Spring." Articles Vegetation, Development of Seeds and Plants, Vital Powers of Plants, &c.

is, that two different modes have been adopted in the growth of vascular plants, with obvious reference to the state of external nature in the latitudes where they are respectively placed; the one of which is named *exogenous*, the other *endogenous*. In the former, the successive additions to the substance of the stem, are made on the exterior side of the parts from which they proceed; in the latter, this process is reversed, and the growth is the result of additions made internally. All the trees of the regions north of the tropics, belong to the *exogenous* order; while a large proportion of tropical plants belong to the *endogenous*.

Of endogenous plants, the palm-tree may be taken as an example. The stem of this tree, in its usual state, is perfectly cylindrical; it attains a great height, and from its summit sprouts a considerable tuft of leaves. It is composed of an extremely dense external layer of wood, while the texture of the interior gradually becomes softer and more porous as it approaches the centre. With regard to its essential character, however, it appears to be uniform in every part, having neither medullary rays nor true outward bark, nor any central pith; in all which respects it differs entirely from the ordinary exogenous trees.

In the first stage of its growth, a circle of leaves is formed, shooting upwards from the neck of the plant, and attaining, during the first year, a certain height. The following year another circle of leaves arises, which grow from the interior of the former circle, forcing it outwards as their vegetation advances, and as woody matter is deposited within. Thus the growth proceeds, each succeeding year producing a fresh crop of leaves intermixed with ligneous matter; and these, exerting an outward pressure, extend and swell outwards the layers in which they are enclosed, until the latter, acquiring greater density, no longer admit of further distention, and remain permanently fixed. This solidity of texture first takes place in the outermost and oldest

layer, the internal layers being consolidated each in its turn. As soon as the outer layer is rendered too hard for yielding to internal pressure, the vegetative force of the inner layers is immediately directed upwards. In this manner the tree rises by successive yearly stages, the growth always proceeding from the interior; a mode of development which has been compared to the drawing out of the sliding tubes of a telescope. The whole stem, whatever height it may contain, never increases its diameter after its outward layer has been consolidated. A circle of leaves annually sprouts from the margin of the new layer of wood, leaving, when they fall off, a circular impression round the stem, by means of which the age of the tree may be ascertained.

Notice has elsewhere been taken of the complicated structure of exogenous trees,* which are composed of wood, bark, and pith. A few words may be here said of their mode of growth, which differs so entirely from that above detailed. The plant in both cases rises from a germ; but, in the trees now under consideration, the stem gradually swells in thickness as it extends in height, consisting of the first layer of wood, with its central pith and its covering of bark. This is the process of the first year. In the succeeding spring a fresh impulse is given to vegetation, and a new growth commences from the upper end of the original stem, as if it were the development of a new bud; and, at the same time, a layer of cellular tissue is formed by the deposition of new materials on the outside of the former wood, and between it and the bark. This is followed by a second layer of wood, enveloping the new layer of cellular tissue. While this process is going on in the wood, corresponding changes take place in the bark, and a new layer is added on its inner surface, which is called the *liber*. All these additions to the thickness, of course, press against the bark, which, being elastic, yields to the pressure to a certain extent, but at length gives

* See "Spring."—Development of Seeds and Plants, &c.

way, forming numerous cracks; and these are filled up by the exudation of the vegetable matter, called *cambium*, formerly mentioned.

Such is a general statement of the different processes of growth in exogenous and endogenous plants, constituting a very striking difference in the constitution of vegetable substances in different climates. That this difference is the contrivance of Creative Wisdom to adapt vegetation to the diversities of light and heat, and the other constituents of the weather in various latitudes, cannot reasonably be doubted by any person acquainted with the system of nature; but the processes of vegetation are too obscure, and the effects of the atmosphere under different modifications are too little known, to enable us distinctly to show the final causes of these alterations; and all, perhaps, that can be positively asserted on the subject is, that the one class of plants droops and decays when transferred to the locality of the other,—a sufficient proof of a profound and calculated adaptation.

In various other particulars, not elsewhere mentioned, the adaptation can be more easily traced, because it depends on known mechanical laws. Thus, the graceful curve with which the stem of a tree rises from the ground, is the form obviously best calculated to give stability to the trunk. Evidence of express mechanical design is likewise afforded by the manner in which the trunk is subdivided into branches, spreading out in all directions, manifestly for the purpose of affording the leaves a greater extent of surface, and thus enabling them to receive the fullest action of both light and air, so essential to the health of the tree. The branches also are so constructed, as to yield to the irregular impulses of the wind; and again, by their elasticity, to return to their natural positions; and by their alternate inflexions on opposite sides, to promote the motion of the sap, and thus to contribute to the healthy action of the vegetable powers.

If any person is inclined to attribute the circumstances we have mentioned to the accidental combinations of unintelligent agents, the best answer which can be given is to refer him to the thousand other instances of design which appear in every department of nature. We do not rest the argument on a few insulated facts; but confidently appeal to the whole tendencies of the principles which regulate the material world, and to the innumerable minute particulars which display an intelligent and beneficent Hand. The facts above detailed might have little weight if they stood alone; but they are individual illustrations of a universal system, and in this light are valuable, as adding to the cumulative evidence, which so irresistibly constrains the mind to acknowledge a present Deity.

SECOND WEEK—WEDNESDAY.

HORTICULTURE.—PRINCIPLES ON WHICH IT IS FOUNDED.

In turning to the consideration of vegetable substances, as they exist during the summer months, it is necessary that we should make a very limited selection, for they are so various, and their history and properties are so interesting, that volumes might easily be written on this subject alone. For this reason, I shall confine myself to plants which man has appropriated to his own use; and shall commence with the varied products of the garden, noticing those only which are the most valuable or the most remarkable.

Gardening is a branch of agriculture at once important and interesting. It depends for its existence on the bountiful provision which the Creator has made for the supply of vegetable substances fit for human nourishment and enjoyment during all the productive seasons of the year, exclusive of the cereal plants, which are only reaped in autumn, and seem more especially destined

to furnish food to be stored up for relieving the wants of the unproductive season of winter. The paternal care of the Creator, in the respect I have mentioned, is very conspicuous. The constitution of these different kinds of plants points out their intended uses; and there is at once a grateful variety, and a wise adaptation to the circumstances of man in such productions, which cannot be sufficiently admired. Had the whole of Nature's bounties been crowded into the autumn months, not only would the unequal distribution of labour, elsewhere mentioned,* have been productive of serious inconveniences, but we would have been deprived of the healthful and agreeable varieties afforded by fresh culled vegetables, with their succulent properties and pleasant flavour. While corn is in every respect wisely contrived for hoarding, the grain being full of a hard and nutritious farina which is stored in small bulk and easily preserved, and the straw being a useful fodder for cattle, the classes of plants which we have now to consider do not, generally speaking, possess such qualities, because these are not necessary for their particular object; but they are endowed with others not less admirable or beneficently suited to the purposes of nourishment; and they are evidently intended to supply a desideratum in the provision made for the subsistence of the highest class of animated existences.

There is a principle in the condition of man, already frequently alluded to, and which must be constantly kept in view in forming an estimate of Creative Intelligence regarding the adaptation of external nature to that condition,—I mean the obvious intention, that his powers and faculties should be stimulated by the necessity of laborious exertion. For this purpose, it seems essential, or at least highly important, that his food should be naturally scanty, but that it should be capable of being rendered abundant by cultivation. The opera-

* See "Spring."—Article—The Labours of the Husbandman wisely Distributed over the Year.

tion of this providential arrangement has been already explained in relation to agriculture;* and the principle holds no less true as regards the produce of the garden. The herbs, plants, and flowers, which form the delight and profit of the horticulturist, are found, in their natural state, sparingly scattered over many regions of the earth. They exist just in sufficient quantities to attract the attention of man, and to preserve the species till he shall appropriate them. But they do not, in general, grow naturally in such abundance as to form very important articles of food. Other plants, such as grasses, which are created for the food of numerous tribes of the lower animals, and trees of the forest, the uses of which are so extensive both for man and beast, are endowed with vegetative qualities which tend to overpower and supplant, or rather to confine to narrow localities, the vegetable productions of which we speak. While this is a wise adaptation with reference to those animals which "neither sow nor reap, nor gather into barns," because it is thus that the universal Father provides for their subsistence, it is no less wise as respects the race who do exercise these functions, and whose industry and ingenuity it calls forth. Man is thus compelled to adopt and cultivate the succulent food destined for his use; and in the exertion of the bodily and mental faculties which his Maker has bestowed, while his toil is rewarded, he finds a thousand collateral advantages accruing to him, and accumulating in a constantly increasing *ratio*.

What greatly adds to this beneficial effect is, the power with which culture is endowed of improving the natural productions subjected to its influence. The flowers, the esculent vegetables, and the roots which the horticulturist rears, all receive, under his plastic hand, new and important qualities; or, at least, the properties they naturally possess, acquire additional value. Of one class, the colour, the perfume, or the symmetry, is im-

* See "Spring,"—Origin of Agricultural Labour, &c.

proved,—of another, its size, its richness, or its succulent or prolific qualities. That which in its natural state was a worthless weed, is converted, by judicious management, into a valuable garden herb, or beautiful flower; and even the thorns and briars of the wilderness become the ornaments of our parterres and lawns.

Such are the principles impressed on the vegetable creation, which gave origin to the skill of the gardener, and have raised his laborious profession to the dignity of a science. The herbalist, the florist, and, in a still higher department, the botanist, each finds exercise for his powers, and regard for his labours, in the various duties of horticulture; and nowhere does the lover of rural pleasures acquire a more exhilarating or healthful pursuit than in the cultivation of the field of contemplation which such studies unfold to him. There is in this delightful employment, so much at once to gratify and refine the taste, to enlarge the mind, and to occupy the pious feelings, that it is not surprising that, in every age of civilized society it should have formed a favourite relaxation to the higher ranks; while, in the more humble, but certainly not less important, view of a useful means of subsistence, there is so much to recommend the produce of the garden to general attention, that it could not fail to become an object of desire to all classes of the community.

It is obvious that the art of the gardener must increase in importance with the advancement of society, and especially with the progress of commerce. At first the gardens of the poor, and even of the middle classes, would contain nothing but a few indigenous plants of prime necessity. The rich, themselves, would, in the infancy of society, differ from their poorer neighbours more in the extent than in the variety of their horticultural productions. But, as soon as commerce had opened up a ready intercourse with foreign nations, the case would be quickly altered. There would be an extensive interchange of the produce of the soil in different

countries, and a stimulus would be given to the skill and industry of the gardener, which would constantly increase, and would be attended with important advantages. The principle of competition, in short, and the desire of profit, which operates so extensively, and in some respects so beneficially, in regard to commercial pursuits, would not fail to be introduced into this department. The wider field laid open, would operate, along with the increasing opulence and extent of the population, to give importance to horticultural labours, and a new class of men would be introduced, by the separation of the profession of gardening from other avocations. This is, in reality, the view, as we shall presently see, which history affords of the progress of the art. Originally, the duty of cultivating the little patches of garden ground devolved almost exclusively on the members of the family,—chiefly, perhaps, on the females; but as the population became more dense, and the demand for conveniences and luxuries more eager and extensive, public gardens were formed in the neighbourhood of towns,—private gentlemen extended their garden ground,—and that was converted into a separate employment, which was originally *nothing* more among all ranks than what it is still among our peasantry—a mere appendage to household labours.

SECOND WEEK—THURSDAY.

HORTICULTURE.—ITS HISTORY.

In looking back to the history of gardening, it is impossible to forget that this was the occupation of the first man. At his creation, God provided for him a garden, in which, doubtless, was collected all that could charm the eye, or gratify the appetite, and set him "to dress it, and to keep it." This indicates that, even in his primitive state of innocence, industrious employment—some-

thing which might gently stimulate the faculties of his mind, and afford exercise to his bodily powers—was essential to his welfare. It was not simple occupation which became part of his curse at the fall; but severe and incessant toil. His employment must have had some useful aim; and hence we may conclude that, even when creation came first from the hand of the Eternal, there was a tendency in the vegetable world to rise into too luxuriant growth, which it was necessary to restrain by art. We may go farther, and conjecture, that cultivation was rewarded then, as it is still, by forms of beauty, becoming, under the plastic hand of man, still more beautiful, and objects of utility still more useful. It would be easy and delightful to expatiate on a theme so inviting to the imagination, but at present we have to deal with recorded facts.

We hear nothing further of gardens before the flood; but, very early in the history of the Israelites, and throughout its whole continuance, they are mentioned in such terms as to show that they were not only familiar to that people, but objects of enjoyment. There is nowhere, however, any mention of the productions they contained, nor of the mode of their culture, if we except the very general title which sometimes occurs of "a garden of herbs," and the frequent allusion to the act of watering in connexion with the name. It will scarcely fail to strike any mind which has been accustomed to turn its attention to scriptural analogies and contrasts, that as it was in a garden that Adam spent his days of innocence and happiness, so it was in a garden that He who has been emphatically called the Second Adam, experienced the mysterious and amazing agony which formed the prelude to his vicarious sufferings.

In profane history, we meet with frequent mention of gardens, as existing in very early ages, often, however, mixed up with fable, and seldom accompanied with any circumstantial account which can throw light on the taste of the ancients, or the kinds of produce which they

cultivated. The hanging gardens of Babylon form some exception to this remark; but, while they convey to us an idea of expensive magnificence and extravagant luxury, the details are far too vague to satisfy the curiosity of a horticulturist, as to those matters in which he feels the greatest interest. Nearly the same thing may be observed of the Persians. They are said to have been addicted to gardening from a very early period; but we know nothing of their arts of cultivation, and we hear from historians only of those gardens which were erected to gratify the profuse taste of monarchs, or to contribute to their oriental splendour.

From Theophrastus and Aristophanes, we learn that the Greeks took pleasure in horticultural pursuits; but they only tell us, in general terms, of the cultivation of flowers, of which that elegant people were exceedingly fond. They strewed them at their convivial meetings, and religious ceremonies; they wore them in garlands and crowns; and they attached to them mythological types and meanings which gave a peculiar and superstitious interest to their culture, and to the manner in which they were employed.

From the Greeks, the Romans borrowed many of their habits and tastes, with considerable modifications, however, consequent on their more warlike propensities. Their love of gardening may probably be traced to their admiration of the people whom they acknowledged to be their masters in the arts and refinements of civilized society. The productions which they cultivated, however; were perhaps more numerous than those which adorned the gardens of the inhabitants of Greece, because the range of their conquests was more extensive; and this active and observant people never failed to appropriate to themselves whatever was useful in the practices or possessions of the countries they over-ran; while, with a generosity, which in some degree compensated for their selfishness, they were eager to communicate to the vanquished the knowledge and the arts of civilized life,

which they had themselves acquired. Although we have little specific information on the subject, it may well be believed that they carried with them, wherever they made a permanent settlement, an acquaintance with the useful labours of the gardener.

In China, it is probable that horticulture was early cultivated, and the inveterate habits of that singular people render it likely that their present modes of garden culture have been handed down from a remote antiquity. The missionary Jesuits Du Halde and La Comte, who resided a number of years in China, mention in terms of commendation the manner in which gardens are managed in that country, particularly as relates to the raising of culinary vegetables; and it is even said that the Chinese are in possession of some esculents peculiar to themselves. This latter assertion, however, is not very probable, as we possess several valuable additions to our flower-gardens, derived from that quarter; and, among the rest, some beautiful varieties of the Camellia, Pœonia, and Rose; and there seems no reason why, if useful vegetables, unknown in Europe, existed among them, these productions should not also have found their way beyond the bounds of the celestial empire.

In turning to the state of European horticulture, in modern times, we shall find that the changes which have taken place in society since the classic ages, have not been less remarkable in this than in other arts. Among the natives of modern Greece and Italy, there are few remains of the habits of the ancient inhabitants. They possess gardens, indeed, but they seem to take little interest in their cultivation. The same vegetable productions which we possess, are to be found in the Italian states; but, while the gardens of the peasants are only scantily supplied with gourds and Indian corn, the arts of horticulture are but languidly pursued even by the wealthy; and it is only in the gardens attached to religious houses, that we see any remains of the taste of former times. In Russia, the practice of gardening was first introduced,

along with many other improvements, by Peter the Great; but it does not seem to have taken deep root, and is indeed almost exclusively confined to the higher classes.* In the adjoining kingdoms of Poland and Prussia, the peasantry have not much more taste for gardening than their less civilized neighbours. Cabbages and potatoes are almost the only vegetables which their little plots produce; but the case is different with their superiors, who raise garden productions in great variety and abundance.

France, particularly in its northern provinces, and the neighbourhood of the metropolis, is distinguished by the attention which is frequently paid to the neatness of the garden grounds, and the success with which the art is cultivated. But, above all the continental nations, the palm must undoubtedly be assigned to the Dutch, and the inhabitants of the Netherlands. Throughout these countries, as has been justly said by Sir William Temple, "gardening has been the common favourite of public and private men,—a pleasure of the greatest, and a care of the meanest,—and indeed an employment and a possession for which no man there is too high or too low."

The early intercourse of Spain with the New World, created a taste in that country for horticultural pursuits, and has been the means of diffusing over Europe many useful plants, from Mexico, Chili, and Peru. In Mexico, indeed, the natives were remarkable for the ingenuity of their garden cultivation; and their chinampas, or floating gardens,† must be considered as one of the greatest

* "Horticulture has attained to a high degree of perfection in Russia, among its princes and nobles; and it is a curious fact, that more pine-apples are grown in the immediate vicinity of St Petersburgh, than in all the other countries of continental Europe."—*Library of Entertaining Knowledge.* —*Work on Vegetable Substances*, p. 206.

† Humboldt conjectures that the first idea of these floating gardens may have been suggested by nature herself, seeing that, "on the marshy banks of the lakes of Xochimilco and Chalco, the agitated waters, in the time of the great floods, carry away pieces of earth, covered with herbs, and bound together with roots. The first Chinampas were mostly fragments of ground, artificially bound together and cultivated." Following up this suggestion

curiosities of art ever produced by a semi-barbarous people.

But nowhere, with the exception perhaps of the Low Countries, is the art of horticulture carried on, among all ranks, with so much spirit and success as in Great Britain. The lowest peasant delights in the labours of his garden; and even the inhabitants of our towns find enjoyment from the cultivation of but a few yards perhaps of soil, which their circumscribed boundaries have spared to them. A taste for shrubs and flowers is universal, especially in the southern districts of England. "The laborious journeyman mechanic," says Mr Loudon, "whose residence in large cities is often in the air, rather than on the earth, decorates his garret window with a garden of pots. The debtor, deprived of personal liberty, and the pauper in the workhouse, divested of all property in external things, and without any fixed object on which to place their affections, sometimes resort to this symbol of territorial appropriation and enjoyment; —so natural it is for all to fancy they have an inherent right in the soil, and so necessary to happiness to exercise the affections, by having some object on which to place them."*

SECOND WEEK—FRIDAY.

HORTICULTURE.—THE TURNIP.

Among the plants which are cultivated in the garden, as well as in the field, I have elsewhere† described two

it would not be difficult, by means of wicker-work, formed with marine plants, and a substratum of bushes, combined with tenacious earth or clay, to construct similar gardens of adequate dimensions. Upon these was placed fine black mould, sufficiently deep for the subsistence of the plants which it was desired to raise. The form usually given to these Chinampas was quadrangular, and their size varied from 150 to 300 feet in length, with a breadth of from 20 to 70 feet."—*Vegetable Substances used for Food*, p. 207.

* Loudon's Encyclopedia of Gardening, p. 95.

† "Spring," p. 342-6.

varieties of the leguminous tribe, the pea and the bean. There is another species of esculent vegetable, some varieties of which are raised by the agriculturist, and others by the gardener. I allude to the turnip, with which I shall begin my selection of horticultural produce.

The native country of this useful bulb has not been distinctly ascertained. Both in France and England, plants of the same species are found in a wild state; but, till it be cultivated, it is of little value; and experiments have proved that, in this climate, the indigenous plant cannot, by any mode of culture, be so improved as to be rendered useful. There hangs a mystery, therefore, over the origin of this, as well as several other of our useful cultivated vegetables.

The turnip was familiar to the Romans, and cultivated by them with great care and success. Pliny and Columella agree in considering this esculent as next to corn in utility; and the latter recommends the extended cultivation of it, both as the food of human beings and of cattle. It is supposed that the Roman method of cultivation must have been superior to that of the moderns, since Pliny relates that some single bulbs weighed as much as forty pounds, a weight double of that obtained by the most skilful modern agriculturist. If this statement can be relied on, it seems to prove something more than mere agricultural skill; for the climate of Italy at present is too warm and dry to be favourable to the growth of this species of produce; and hence it may be fairly inferred, that a considerable change has taken place in the temperature of that country,—a fact, indeed, which is established by more direct proof, as I have elsewhere shown.* It is well known that the turnip attains greatest perfection in regions where the climate is moderately cool and moist. Thus, in the north of England, and in Scotland, the crop is superior to that raised in the more southerly parts of the island. It cannot, however, bear a great degree of cold, and the regions bordering on the

* "Spring"—Mitigation of Seasons occasioned by Cultivation.

Arctic Circle are, on account of the dryness and warmth of their brief summer, and the rigour of the first part of the year, peculiarly unfavourable to its growth. Its successful cultivation, therefore, in the field, seems to be circumscribed to a comparatively narrow boundary towards the north and south; but, as a garden plant, where luxuriant growth is not required, and would indeed injure instead of improving the quality of the plant for culinary purposes, it is far more extensively raised. At Benares, in Hindostan, a latitude of about 26°, turnips, as well as several other northern vegetables, are raised in considerable quantities; and although, in that hot climate, they lose much of their peculiar flavour, are yet eaten with great relish by the European inhabitants.

The turnip is a biennial plant; but it is not permitted to attain to its second year's growth by those who cultivate it merely for food, as it becomes deteriorated in its edible qualities when it begins to produce its seed stalk. After surviving the winter, its large radical leaves having fallen off, a stem shoots up which bears flowers, having the four petals arranged in the form of a cross, and hence called cruciform. The varieties, both under garden and field culture, are very numerous;* while these again differ with soil and climate, and modes of cultivation. The agriculturist seeks to obtain the greatest quantity of nourishment for his cattle in a given space, and therefore selects those kinds which are at once largest in bulk and firmest in texture; the gar-

* In the account of the turnip, published in the Library of Entertaining Knowledge, it is said that ten varieties are in common cultivation, distinguished by colour, size, time of coming to maturity, productiveness, or flavour. Among these the following are particularly noticed:—The Maltese golden turnip, of one uniform orange tinge, perfectly spherical, and of a fine flavour, sometimes introduced with the dessert, instead of fruit; the Swedish, a field turnip, the most hardy of any under cultivation, but strong and harsh to human taste; the French turnip, or *navet*, carrot-shaped, which is much esteemed on the Continent for its flavour; and the Barbary turnip, parsnip-like, with fibrous roots, which is prized for its agreeable pungency.

dener, on the contrary, studies flavour and beauty; which he discovers to be incompatible with great size.

As an article of human food, the turnip does not appear to be held in so much request, nor to be prepared in so many ways in our own day, as in former times. In the Philosophical Transactions, we are told that during the occurrence of a dearth in England, in 1629 and 1630, "very good, white, lasting, and wholesome bread," was made of boiled turnips, deprived of their moisture by pressure, and then kneaded with an equal quantity of wheaten flour. The scarcity of corn in 1693, led the poor of Essex again to have recourse to this species of bread. It could not, we are told, be distinguished by the eye from a wheaten loaf; neither did the smell much betray it, especially when cold.*

The ancients seems to have excelled in the mode of dressing this vegetable. The "Curiosities of Literature," record the following amusing anecdote, which shows to what extent the art of gastronomy enabled the cooks of those days to transform this article of food. The King of Bithynia, in some expedition in which he found himself, in the midst of winter, at a great distance from the sea, took a violent longing for a small fish, called *aphy*,—a pilchard, a herring, or an anchovy. The longings of monarchs at the head of victorious legions are not to be disregarded. But what was to be done? His cook, who was a master of his art, and fertile in expedients, surmounted the difficulty. He took a turnip, and cut it to a perfect resemblance of the *aphy* in shape. He then "fried it in oil;" and being "salted and well powdered with the grains of a dozen black poppies," his majesty's exquisite taste was so deceived by it, that he "praised the root to his guest as an excellent fish."†

Turnips do not contain so much nourishment as some other garden vegetables. Sir Humphry Davy's analysis gives only forty-two parts of nutritive matter in a thou-

* Philosophical Transactions, Nos. 90 and 205.

† Curiosities of Literature, vol. v. p. 88.

sand parts of the common turnip, and sixty-four in a thousand of the Swedish.

I have observed that Pliny's account of the growth of turnips in Italy, seemed to indicate that the soil and climate of that country in his day, was far more favourable for their cultivation than at present exists, not only in that southern latitude, but even in this country. The ordinary weight of a turnip, under British culture, is about six or seven pounds, but in favourable circumstances these bulbs frequently reach as high as sixteen, and in some rare instances, even twenty pounds. It is stated by Mr Campbell,* that in 1758, a turnip was pulled at Tudenham, in Norfolk, which weighed twenty-nine pounds, and this seems to be the largest on record in modern times. Dr Desaguliers has made a curious calculation on the rapid increase of the turnip, which affords a remarkable proof of the power of vegetation. One ounce of turnip seed was found by him to contain from fourteen to fifteen thousand single seeds; whence it follows that one seed weighs upwards of a fourteen thousandth part of an ounce; and comparing this with the weight it acquires in growing, he calculated that, supposing the increase to be always uniform, it may acquire fifteen times its own weight in a minute! By an actual experiment made on moss or peat ground, turnips have been found to increase by growth 15,990 times the weight of their seeds each day they stood upon it. "It is not, however, only the size and weight of the root which renders this crop so productive. The number contained in a given space, with reference to their size, is very great. Some writers speak rather marvellously on this subject, but it is generally thought a good crop when a turnip is obtained from each square foot of ground. Mill considers an average crop to be 11,664 roots per acre, which, at six pounds each, will be 69,984 pounds."†

* Political Survey, vol. ii.

† Library of Entertaining Knowledge,—Vegetable Substances, p. 235.

From these statements we may be enabled to form some estimate of the amazing power which the Creator has put into the hands of man, by subjecting the vegetable world to his skill in the arts of cultivation. The cultivator of the soil may be said to create food for himself and his dependant animals out of the earth. It is not, however, by miracle, but by making a judicious use of the powers impressed on nature by an omnipotent and paternal Hand, that such an effect is produced. This view opens a wide field of contemplation, to which we have already adverted. The varied and peculiar means by which external nature, in all its departments, is adapted to the circumstances of the human race, and calculated to call into action, and give salutary exercise to their powers and faculties, is an exhaustless theme of admiration and gratitude.

SECOND WEEK—SATURDAY.

HORTICULTURE.—BRASSICA, OR CABBAGE.

The turnip is considered by naturalists as of the *brassica* class, one of the features of which is breadth of leaves, and its young sprouts are often used for culinary purposes, instead of the common colewort. It is of the varieties which bear the general name of cabbage, that I am now to speak.

Of this vegetable, some kinds have been cultivated from the very earliest times, of which we have any record. Its history, however, is but little known; and as this particular genus of plants is peculiarly liable "to sport and run into varieties and monstrosities," it is not probable that we possess it in the same state in which it was used by the ancients. Be this as it may, it is in its present state, as it was among them, a very useful and agreeable addition to our articles of food.

The brassica belongs to the numerous family of the

Cruciferæ, which furnish great varieties among esculent plants. The roots, the leaves, the stems, and the buds of different species, are eaten raw, or dressed in various ways; and the seeds of many kinds afford a valuable oil. None of the family are directly poisonous. In their fresh state, they either contain a portion of nitrogen ready formed, or have the power of detaching it from the atmosphere, when they begin to undergo decomposition. This quality displays itself sooner in the leaves than in the roots, and to it is owing the very unpleasant odour of the water in which cabbages have been boiled.*

All the kinds of cultivated brassica, the leaves and flowers of which are eaten, belong to the species *oleracia*. This contains many varieties, and almost endless subvarieties, but they may all be reduced into the three distinctly marked classes of cabbage, kail or colewort, and cauliflower. Of the first, the leaves gather into what is called a head, and are blanched by their own compression; of the second, the leaves are expanded and coloured, with the exception of a small portion in the centre, which encloses the rudiments of the flowering stem; of the third, the flowering stem is short and succulent, the rudiments of the flowers forming into a curd-like head, which does not rise higher than the leaves, and becomes a mass of matter before the corolla, or any other part of the flower, is developed. The leaves of the two first kinds, and the curd-like head of the last, are used as food.

It is interesting to know something of the habits and tastes of the ancients in their food, as well as in other particulars; and it may therefore not be thought superfluous to state, that Chrysippus and Dieuches, two physicians, wrote each a book on the properties of the brassica, as well as Pythagoras and Cato, all of whom, and especially the latter, recommend it as a most valuable culinary plant. Pliny mentions it as "in great request

* Library of Entertaining Knowledge, article Vegetable Substances, p. 237.

in the kitchen, and among riotous gluttons," alluding probably, by the latter expression, to the quality it was supposed to possess of restoring the tone of the stomach after deep potations. The same author, in speaking of the spring sprouts of colewort, says, " Pleasant and sweet as these crops are thought by other men, yet Apicius,—that notable glutton,—loathed them, and by his example, Drusus Cæsar held them in no estimation, but thought them a base and homely food; for which nice and dainty tooth of his, he was well checked and reproved by his father Tiberius the Emperor."

This ancient naturalist gives directions for the cultivation of brassica, which may also be stated. " If you would have very fine plants," says he, " both for sweet taste and great produce, first let the seed be sown in ground thoroughly dug over more than once or twice, and well manured; secondly, you must cut off the tender young stalks, that seem to put out far from the ground, and such as run too high; thirdly, you must raise mould or manure up to them, so that there may be no more above the ground than the very top."—" There are," continues he, " many kinds of brassica in Rome, such as that of Cumes, which bears leaves spreading flat along the ground, and opening in the head; those of Aricia, which are tall and send forth numerous shoots; and the colewort Pompeianum, so called from the town Pompeii, which also grows high, and sends out many tender sprouts."* Referring to the Aricia plants, he afterwards adds, " It is not long since we have procured a kind of cabbage-cole from the vale of Aricia, with an exceedingly great head, and an infinite number of leaves, which gather round and close together." He further speaks of some coles which assumed a round shape, others which extended in breadth, and were very full of

* Pliny also mentions the brassica of Calabria, remarkable for its large leaves, small stalks, and acrid taste; and the Sabellian brassica with curled and ruffed leaves, a small stem, and a head of wonderful size, which latter was much esteemed for its sweetness.

fleshy fibres; and others again which bore a head twelve inches thick, and yet none put forth more tender buds.

In some of these descriptions we recognize a very distinct resemblance to several kinds still in existence, with such differences as might be expected to exist at such a distance of time in an order of vegetables, the pollen of which so freely intermingles with the seeds of others of the same genus, producing new species. It is not uninteresting to observe, both the agreements and the differences subsisting between ancient and modern horticulture; and it is especially pleasant to remark among horticulturists of former days, the same kind of eagerness to obtain and give publicity to new varieties, which prevails at present.

Many fanciful notions were, in the classical ages, entertained of the medicinal qualities of brassica. Both the Greeks and Romans used its juice, with honey, as an eye-salve; they mixed it with goats' milk, salt, and honey, for the cramp; they took it inwardly, as a remedy against poisonous mushrooms, as a purifier of the blood, and as a clarifier of the brain after intoxication. The plant was prepared as a liniment to assuage swellings of the glands, and to restore blackened bruises to their natural colour; they bruised it raw, with vinegar, honey, rue, mint, and the roots of laser, as a cure for the headache, the gout, and many other complaints; they recommended it to mothers, who were nurses; they even prescribed it for the palsy, for tremblings of the limbs, from whatever cause, and for vomiting of blood.*

Of the cabbage, properly so called, a preparation is made by the process of fermentation, which the Germans, who are immoderately fond of it, call *Sauerkraut*. The manufacture of this article of food is carried to a great extent by the Tyrolese, among whom it forms a separate profession. "October and November are the busy months for the work, and huge white pyramids of cabbage are then seen crowding the markets; while, in every court

* Phillips on Cultivated Vegetables.—Article Cabbage.

and yard, into which an accidental peep is obtained, all is bustle and activity, in the concocting of this national food, and the baskets, piled with studded cabbage, resemble 'mountains of green-tinged froth or syllabub.'"* This preparation has been found to be of sovereign efficacy as a preservative from scurvy during long voyages. It was for many years used in our navy for this purpose, until displaced by lemon-juice, which is equally a specific, while it is not so bulky an article for store.

A variety of brassica, under the name of cow-cabbage, has been recently introduced into this country, from La Vendée, by the Comte de Puysage. The proximity of this department to the ancient province of Anjou, and the description of the plant, leave no doubt of its identity with the Anjou cabbage,—a very large variety described by Mill.† In 1827, thirty-six seeds were, according to the Gardeners' Magazine, divided among six agriculturists, for the purpose of raising this useful vegetable in England. The perfect success resulting from some of these seeds, which have produced plants of luxuriant growth, is already known; and very recently the speculation of a spirited individual has rapidly diffused it over the kingdom, so that there is every reason to hope, that the cow-cabbage will immediately come into extensive cultivation in Great Britain. It is said that sixty plants afford provender sufficient for one cow, during three or four years, without fresh planting. A square of sixty feet will contain 256 plants, four feet apart, which are sixteen plants more than four cows require for a year's provender, without the aid of other food. Were we to give way to the anticipations, which this and similar facts might excite, of the powers inherent in esculent vegetables that yet remain to be developed by the skill and industry of man, views might be unfolded of the future population of the globe, almost too magnificent for the imagination to follow. There are, however, too many counteracting circumstances in the pre-

* Vegetable Substances, p. 263. † Mill's Husbandry, vol. iii.

sent state of society, to permit a man of judgment, chastened by experience, to indulge these views without abatement.

One important reflection, indeed, which I have not elsewhere overlooked,* again presses itself on our notice. Such facts only form a branch of a great department of natural phenomena, which prove that energies are impressed on creation, lying, as it were, in abeyance and reserve, till the ingenuity of man shall call them into action. Thus, in the present and similar instances, the inconveniences arising from the superabundant power of *animal* reproduction are in continual course of mitigation, by the interference of man in stimulating the superabundant power of *vegetable* reproduction; and as human society advances in knowledge and civilization, the number of mankind, and that of living beings destined for their use, is increased, and their welfare provided for; while, by the enlarged resources so acquired, the human faculties find room to expand, and those ulterior intentions of the universal Parent are urged forward, of which revealed religion has opened so glorious a prospect.

* See "Spring," pp. 36, 38. Third Edition.

THIRD WEEK.—SUNDAY.

SPIRITUAL LIGHT.

The analogy between the light of the sun, and that moral illumination which is shed on the soul by Him who is emphatically called "the Light of the World," is very frequently alluded to in Scripture; and the splendour which now shines around us naturally raises our thoughts to this animating subject.

There are various interesting views in which this analogy presents itself. Sometimes it is employed to illustrate the progressive nature of religion in the soul, as when it is said, "the path of the just is as the shining light, which shineth more and more unto the perfect day." This comparison is at once apt and beautiful. First on the dark bosom of night the day star appears; then breaks forth the lovely dawn, shedding over the face of heaven and earth a faint, but grateful and increasing light. At length opens the bright eye of day, and the broad and deep shadows of morning mingle and are contrasted with the lustre of the new-born rays. Higher and higher the sun takes his course in the heavens, till hill and valley, wood and stream, glow as he shines: till the shadows soften and are diminished, and till all Nature rejoices in the universal blaze. And so it is with the Christian. In the morning of his spiritual day, how faint is the light of his graces, how broad and deep the shades of his remaining ignorance and sin! But as the day advances, his illumination and fervour increase; the dark shadows of his character become less conspicuous; they are contracted in their dimensions, and mitigated in their intensity, till one by one they disappear; or by the contrast only show his virtues and graces more bright. It is thus that he approaches his noon; but, alas! he attains it not in this sublunary

state. Clouds intervene and storms lower, and before all that is dark in his character is removed, he suffers the eclipse of the grave; only, however, to shine forth as the sun in the kingdom of his Father.

As the progress of the day may be applied to illustrate the advancement of an individual in Christian truth and religious practice, so the progress of the year may be taken as shadowing forth the gradual, but constantly progressive state of the Christian community. This movement is not always in unison with the advancement of society in the arts and sciences; but, on the contrary, as history and experience abundantly prove, frequently takes an opposite direction. The light of reason and the light of revelation, although they are derived from the same source, and when combined, shed an intenser glory over both the world of nature and the world of grace, are yet, by the perverseness of fallen man, sometimes practically contrasted, and caused to obscure each other. Human wisdom is essentially worldly; and, unless sanctified by the wisdom which cometh from above, it shines with its own meteor light, and is the rival, not the auxiliary, of the Sun of Righteousness. Yet in its own sphere, even then, its powers are wonderful. Within the two last centuries, it may be said to have advanced from spring to summer, and in our own day has produced fruits which have astonished the world. The inventions to which it has given rise, are rapidly changing the face of society and the common relations of life, and seem destined not to stop till they shall have effected a complete revolution in the character and condition of the human race. Under the operation of this principle, knowledge is pouring in on the ignorant, learning becomes more learned, skill more skilful, and ingenuity more ingenious. Industry finds new paths to wealth; luxury new means of gratification; philosophy new departments of study; commerce new and more ample resources. By unheard of means, human intercourse becomes daily more easy and rapid; and mankind, brought

closer together, are united by new ties. To the genius, the talent, and the enterprise of man, who will venture to fix limits?

But look more attentively, and you will find that all these productions of human talent and industry, when unblest by the enlightening and vivifying power of religion, carry in themselves the seeds of their own destruction, and must end in the blight and desolation of winter. The spirit by which the present generation is actuated is selfish, restless, and worldly. In the bustle of life, individual struggles against individual, class against class, interest against interest; while all are fearfully affected by an increasing relaxation of moral and social ties. What is become of those patriarchal feelings which led the higher ranks of society to regard their dependants as members of their own family? Where is that affectionate deference and regard which, in the days of our fathers, graced the intercourse of the poor with the rich? While luxury and dissipation enervate the faculties, and injure the character of the one class, unsanctified knowledge is giving power, and extensive combinations an ominous influence, to the other. To crown all, a reckless disregard of all that is venerable in ancient institutions, and sacred in principle, rises and prevails. The bands of society seem even now ready to burst asunder, and threaten, at no distant period, to desolate the world with blood. If the crisis be not averted, who dare say that science, with its boasted light, shall not be extinguished, and the darkness of ignorance and barbarism again brood over these Christian lands?

But there is one remedy,—there is only one. That remedy does not consist in arresting the progress of knowledge; which would be altogether undesirable if it were possible, and impossible if it were desirable. It consists in enlightening that knowledge, by bringing it under the influence and illumination of Him, whose advent was announced as that of "a light to lighten the Gentiles."

In looking to the future destiny of the human race, it is an unspeakable satisfaction to be assured, by that Oracle which cannot lie, that the time will come, and is now in progress, when the earth shall be filled with the knowledge of the Lord; and when the Sun of Righteousness shall shed the glories of His rays over the whole world. I shall not pretend to fix the period of this blessed era, or dare to pry into "the times and seasons which God has put in his own power." But one thing is certain, whenever that blessed period arrives, the lights of reason and revelation will unite their rays, and it shall be made manifest, that even worldly ingenuity (though it meant not so), has been preparing its discoveries, and elaborating its inventions, to add to the comfort and happiness of the children of the Redeemer. Then science will bestow its knowledge to elevate the devotion of saints, and commerce will give its ships and its engines to facilitate their intercourse; and all the necessaries and conveniences which civilization shall have accumulated, will be employed to fill their hearts with gratitude to the Giver of all good. Then education will open its schools to teach the wonderful things of God; and learning will yield its libraries, and art its stores, to feed the soul with knowledge, and enlarge its powers. Then all things will be sanctified by being employed to promote the glory of God and the good of men; and it will be felt and acknowledged that genius has not laboured, nor science advanced, in vain. Thus shall Providence be vindicated in his dealings with the human race, and all shall be well.

THIRD WEEK—MONDAY.

HORTICULTURE.—VARIOUS GARDEN VEGETABLES.

It would not be consistent with the object of this work, to enter much further into a description of the in-

dividual plants, which form the produce of the kitchen-garden. The specimens already given, serve to show, in two different species, the provision which the Creator has made for the supply of wholesome varieties of food, that may be rendered, by the arts of cultivation, exceedingly prolific, and seem thus destined to add to those resources, by which field and garden labour shall continue, to a period and extent not easily calculated, to satisfy the wants of a rapidly increasing population, and by such means to increase most materially the numbers of living beings, and especially of the human species, on the surface of the globe.

What, before leaving this department of our subject, remains chiefly to be shown, is the great variety of esculent vegetables, in point of quality and flavour, as well as mode of growth, which it has pleased the Creator to place in the hands of the horticulturist. In reference to the latter, there is no part of a plant which we do not find, in some particular species, fit for food. The root, the bulb, the stalk, the leaf, the flower, the seed, each in its turn, is gifted with those qualities, which render it a valuable and agreeable material for culinary purposes. Some of these varieties have already been noticed;—as an instance of edible seeds, I have mentioned the pea and the bean; of edible leaves, the cabbage; of edible flowers, the cauliflower; of edible bulbs, the turnip; of edible roots, the potato:—but of all these there are other kinds, to some of which I shall now shortly advert.

Among roots may be particularized, the carrot, the parsnip, the beet, the skerret, and the scorzonera. The two latter are now almost excluded from the list of vegetables cultivated in the gardens of this country, having been superseded by the more favourite varieties which the others afford, although the scorzonera is a particularly delicate kind of food, and might with advantage be retained. The carrot and parsnip are found wild in this country; but the experiments which have

been made on these native plants have not succeeded in rendering them fit for garden culture; and, like many other of our vegetable productions, they seem to have required a more genial climate for the development of their esculent qualities; although, when once developed, these are retained without degenerating under the ordinary routine of our gardens. The carrot is particularly prized as an agreeable variety at our tables, and, in some parts of the country, it is even extensively grown in the field for the consumption of stock, and, in various instances, with great advantage. Take the following example:—"At Partington, in Yorkshire, the stock of a farm, consisting of twenty working horses, four bullocks, and six milch cows, were fed, from the end of September to the beginning of May, on the carrots produced from three acres of land. The animals, during the whole of that period, lived on these roots, with the addition of only a very small quantity of hay; and thirty hogs were fattened on the refuse left by the cattle."* The nutritive qualities of carrots and parsnips are found to be nearly equal, the former containing 98, and the latter 99, parts of nutritious matter in 1000, of which there are in the carrot 3, and in the parsnip 9, parts of mucilage, the rest being saccharine substance.

The beet, according to Sir Humphrey Davy's analysis, contains more nutritive matter than any other root, excepting the potato, the quantity being 148 parts in 1000, or nearly 15 per cent, of which about 12 per cent is saccharine matter. This large proportion of the latter substance has led to various experiments for its employment in the production of sugar, which has ended in the establishment of this manufacture in France, by the imposition of excessive duties on the importation of sugar from the colonies,—a public act of more than doubtful policy.†

* Library of Entertaining Knowledge, Vegetable Substances, p. 244.

† "The cultivation of the beet," truly observes the Quarterly Journal of Agriculture, "is but one ramification of that system of repulsion and exclu-

Examples of garden herbs, which, like the brassica species, supply varieties of vegetable food in their leaves, are to be found in the spinach and lettuce. The former takes its name from its Moorish appellation, *Hispanach*, or Spanish plant, having been first brought into Europe through the medium of Spain, probably from the west of Asia, where it was early famous for its supposed medicinal qualities. Spinach is an annual plant, having large and succulent leaves. It is chiefly remarkable in botany as being one of that class of vegetables, which has the different parts of fructification on separate plants,—hence named *diœcious*. There is a species of spinach, indigenous in this country, called, somewhat fantastically, Good King Harry, or English Mercury. It is a perennial, and has large arrow-shaped leaves, powdered on the under side. The stem is also powdered, and is upright, thick, and striated. When young, both the stem and the leaves are succulent, the former being used as an asparagus, and the latter as a spinach. It is cultivated in Lincolnshire, where it is preferred to common spinach; but it does not easily accommodate itself to differences of soil and situation. This probably arises from the circumstance of its having been only recently brought into a state of cultivation; for it is worthy of remark, that, among other advantageous changes produced in the character of plants, that of superior docility, as it may be called, is acquired by long subjection to training.

Lettuce is used in its raw state with the dessert, made up with other garden herbs into a salad, and is of so easy growth, and so cooling and agreeable in its qualities, as to be an universal favourite in the gardens even of the middle classes. The species comprises many varieties, all of which possess a milky juice, which is slightly narcotic. This juice is very bitter, and, when it becomes abundant, which takes place as the plant advances

sion, which has been adopted in France, to the oppression of her domestic industry, the ruin of her foreign commerce, and the maintenance of false principles in the commercial policy of surrounding nations."—No. xii.

towards the period of flowering, it ceases to be used at the table. Of late, the narcotic principle of the lettuce has been employed in medicine, under the name of *lactucarium;* and it is believed to possess the virtues of opium, in a mild degree, without producing the same deleterious effects. It has, in some places, become an object of culture for this particular object.

The endive, a native of China, and the succory or wild endive, which is indigenous in Britain and throughout Europe, are employed also as salads, and afford other instances of plants being propagated for their edible leaves.

Of the productions of the garden which have esculent bulbs, the onion is the most remarkable. It is not very nourishing, nor agreeable in its odour, but it possesses a pleasant pungency of taste, which renders it very acceptable, especially to the humbler classes, who use it as the chief relish for their food. This bulb has been an object of cultivation for at least 4000 years. We read in Scripture of the highly-prized onions of Egypt, where the plant is still a favourite article of food. Hasselquist speaks of the Egyptian onion as one of the greatest delicacies in the world, and says, "there is no wonder that the Israelites regretted its loss, and wished to return to servitude, that they might enjoy it!" In this country, the comparative coldness of the climate has caused the onion to degenerate, rendering its flavour rank, and its coats too compact to be easy of digestion.

Among garden plants the shoots of which are used at the table, I may particularize the asparagus and the celery, the top of the former being eaten, and the blanched lower parts of the footstalks of the latter. They are employed entirely as a luxury, and appear only at the tables of the middle and higher classes. The former was cultivated by the ancients, and was held in much esteem in the classic ages. "The head of the young shoot of asparagus is edible just as far as the part that is to flower extends; and thus, one who eats a head

of asparagus eats, in that little space, the rudiments of many hundreds of branches, and many thousands of leaves."*

I shall not extend this enumeration farther. My object has been accomplished, so far as relates to the variety of forms in which the Author of Nature has produced esculent vegetables, although but a very small part of that variety has been noticed. What are still more worthy of observation, as indicating benevolent design, are the differences which exist in the taste and flavour of these productions. In this particular, they all vary from each other. Each produces its own peculiar excitement on the organs of taste, and thus gives rise to very many agreeable sensations. Our great Milton has thought it not beneath the epic dignity of his sublime poem, to represent the mother of mankind selecting and arranging, with the nicest regard to their various and peculiar tastes, the fruits which she prepares as a banquet for her angel guest. The poet had too much fine philosophy not to discern the blessing conveyed in the wonderful variety of tastes possessed by the earth's vegetable productions; and, accordingly, he thus alludes to it in his own inimitable manner:—

"So saying, with dispatchful looks, in haste
She turns, on hospitable thoughts intent;
What choice to choose for delicacy best,
What order, so contrived as not to mix
Tastes not well joined, inelegant, but bring
Taste after taste, upheld with kindliest change;
Bestirs her then, and from each tender stalk,
Whatever Earth, all bearing mother, yields
In India, East or West, or middle shore,
In Pontus or the Punic coast, or where
Alcinous reigned, fruit of all kinds, in coat
Rough, or smooth rind, or bearded husk, or shell,
She gathers tribute large, and on the board
Heaps with unsparing hand."

* Vegetable Substances, p. 276.

The pleasures resulting from the gratification of the senses, are indeed of inferior value; but yet, in estimating the blessings which our heavenly Father has scattered around us, they are not to be overlooked. Like every other gift, they may doubtless be abused, and there is nothing more disgusting than the character of a glutton or an epicure. But, when kept in their proper place, they not only add to the charm of existence, but in many ways form a salutary stimulus to exertion, and produce a useful moral effect on the human character.

THIRD WEEK—TUESDAY.

HORTICULTURE.—FLOWERS—THE ROSE.

Since the culture of flowers became an object of care and attention in this country, their varieties have been much increased. The old world and the new have poured their treasures into British gardens, the greenhouse is enriched with a brilliant crowd of exotics, and the more hardy natives of distant climes flourish among the kindred beauties of our soil. But our own woods and brakes have supplied the principal decorations of the parterre, and it is to the practical gardener a source of the liveliest interest to beautify the wild-flower by skilful management. The little blossoms of the woods and fields, springing from the parent earth, and nourished by the sun and dew, without the aid of human art, have a grace and simplicity peculiar to themselves; they seem the especial property of those who pause to search them out from their mossy beds and hiding-places among the grass,—and who have the taste to admire in each the perfection of structure that marks it as a production of Divine wisdom. The elegance of these wildings appear to indicate that they are designed to soften and refine the mind of man.

" The gentle flowers,
Retired and stooping through the wilderness,
Talk of humility, and peace, and love,—"

and happy is he who has learned to listen to their voice. They are plentifully scattered among the " thorns and thistles" of the wilderness, to mitigate the curse brought on the earth by sin. These are as the lingering relics of the garden of Eden, rich in spontaneous flowers,

" Which not nice art
In beds and curious knots, but nature boon
Pour'd forth profuse on hill, and dale, and plain."

But our woodland favourites may be transformed by cultivation into the noblest flowers, and we recognize them in the garden under a more imposing form, and emitting odours to which many of them were strangers before. The hearts-ease of the woods and mossy banks becomes the bright and perfumed violet and pansy in all their varied and beauteous families. The oxlip assumes the different sizes and colours of the polyanthus; and the butter-cup, that " gem of the field," is discovered in the dazzling varieties of the ranunculus.

Summer is the season of flowers; the earlier kinds which adorn the Spring, have given place to a brilliant succession, opening in the genial heat of the sun. The eye wanders from one to another, comparing, and contrasting, till individual loveliness is lost in the splendid whole. The far-spreading mignionette fills the air with fragrance. The aromatic carnation rises beside the delicate convolvolus, and the iris and the amaranth vie in the brightness of their colouring. But to describe, or even to enumerate the whole would be work for a volume; we shall therefore confine ourselves to the rose, which opens its blossoms from the regions of the sun to the wintry north, and is universally acknowledged as

" The pride of plants, the grace of bowers,
The blush of meads, the eye of flowers."

There are between three and four hundred varieties of the rose, all bearing the same general characteristics amid their diversity of size, hue, and fragrance. The dog-rose, with its five petals and pitcher-shaped calyx, is the pride of our hedge-rows. Its flowers hang in wreaths along the way-side, or decorate the rustic fence around the cottage garden. The bright scarlet hips shining among the naked boughs in winter, form the food of pheasants and other birds, and a conserve is made of the pulp beaten with sugar. The sweet-briar rose resembles this, enlivening the sober green of the woods and hedges with a profusion of red, white, and blush-coloured flowers, and clothing with beauty and verdure those gravelly tracks where less hardy flowers refuse to grow. It is, like the best blessings of mankind, common to all; and we question whether it has been more enjoyed by the poets who have sung the "dew-sweet eglantine," or by the peasant, whose toils have been beguiled by the fragrance of its green leaves, which is among the sweetest of all that scent the morning breeze. The swelling forms of the garden roses, as they burst from the sheltering calyx, present a striking contrast to these. There are the hundred-leaved, including the delicious cabbage-rose, the white Provence, and several other varieties. How inexhaustible are the riches of a single bush! The bud expanding to supply the place of the flower that strews its petals on the earth, leaves us scarcely time to regret its loss, or to feel that a charm is gone. The exuberant flowers adorn the whole summer, and diminish by slow degrees as the autumn advances, as if unwilling to leave the parent stem to cold sterility. What can exceed the beauty of the rose on a summer morning, half-blown, and bathed in dews that shine red in the early sunbeam, as it reflects on them the hues of the folded petals?

"Ah! see deep blushing in her green recess
The bashful virgin rose, that half revealing,

And half within herself, herself concealing,
Is lovelier for her hidden loveliness."

The English rose, the symbol of royalty, is of a rich crimson hue, and large, but not very double. This is the

" Flower which of Adon's blood
Sprang, while from that clear flood
Which Venus wept, another white was born."

This white rose, graceful as is its tall stems laden with innumerable flowers, is rivalled by the rose of Scotland, low of stature, and delicately beautiful, spreading in the shade its modest boughs, covered with a shower of small sweet blossoms, as thick as the snow-flakes of winter.

The yellow rose, which is a native of Italy and the south of France, is comparatively rare in this country, as is the Austrian rose, which is sulphur-coloured on the outside, and scarlet within. The double yellow, which grows wild along the shores of the Levant, is shy of blooming in England, and seldom shows its full and ample flowers in perfection above once in a lifetime.

The rose was among the tasteful Greeks esteemed the first of flowers; nor can any lover of antiquity be indifferent to the sacred flower of the Muses, blooming on the mountain of Pieria. The China rose continues to flourish in winter, when others are faded, and our windows are graced by that which the Romans were at great expense to procure, and for which Nero did not scruple to give £30,000 to decorate one magnificent supper.

The rose grows in the cold clime of Northern Lapland,

" Where pure Niemis' fairy mountains rise,
And fringed with roses, Tenglis rolls his stream."

But in the sunny plains of Persia it attains to its greatest perfection, and the inhabitants of that land consider it especially their own. They call it by many names,

and not only are their gardens filled with it, but their apartments and baths are continually strewed with its ever-opening flowers; and they celebrate its beauties in the Feast of Roses, which is not wholly discontinued as long as it is in bloom. In Persia, the rose-bush sometimes attains the height of fourteen feet. There, too, the air is vocal with the songs of the nightingale, as he warbles where

> "His queen, the garden queen, the rose,
> Unbent by winds, unchilled by snows,
> Far from the winters of the west,
> By every breeze and season blest,
> Returns the sweets by Nature given
> In softest incense back to heaven;
> And grateful yields that smiling sky
> Her fairest bloom, and fragrant sigh."

The rose bears a conspicuous part in the gorgeous poetry of the East, furnishing similes and allusions as numerous as its own flowers; it has been the subject of many fictions and allegories, whose fanciful beauty we might admire, but that they have assisted in leading the darkened mind away from Him, whose beneficence has caused roses to spring up over the earth. The German fable of the origin of the moss-rose is well known. The angel of the flowers, awaking from his slumbers beneath the shade of a rose-bush, offered to bestow whatever it required, and, when it asked for another grace, he threw around the flower a veil of moss. There is also a legend of Palestine, which ascribes the origin of the rose itself to the unjust condemnation of a holy maiden, whose pile, when the torch was applied, became in a moment bright with innumerable roses, the first that had blossomed out of the precincts of the garden of Eden. With these the people, it is said, triumphantly wreathed her head as they conducted her to her home. The name of Syria has been supposed to be derived from *suri*, a species of rose to whose superiority Virgil bears

testimony, when, in describing an era of universal happiness, he says,

" Each common bush shall Syrian roses bear."

In Judea, blighted and forsaken as she is for the sin of her children, there still are " vallies of their roses voluntarily plentiful." The moral desolation, alas! is more complete, and the land has long sighed for the return of the days when her " Rose of Sharon" shall again be an emblem of the more excellent beauty of the Bride, the Church, and when, in the awakening of multitudes to the faith of the Redeemer, " the desert shall rejoice and blossom as the rose."

The custom of strewing flowers around the dead, is probably of a date as ancient as the affection that seeks to associate all that is best and sweetest with those for whom it weeps. The Turks, the Spaniards, and the French, with all their dissimilarities, agree in this; the exalted and the humble have alike gathered roses to scatter round the departed. Milton invokes the musk-rose

" To strew the fragrant hearse where Lycid lies,"

and the peasantry of South Wales vie with each other in planting the graves of their friends with memorial-flowers.

Flowers are not of very general use as food for insects, but the rose-beetle banquets on that after which it is named; the carpenter-bee cuts round patches from the green leaves of the bush to line its nest; and on the rose the butterfly basks in the sunshine, feasting on the nectar it contains.

The crimson rose was much valued by the Arabian physicians; the hundred-leaved also is used for infusions and syrups, and, from the pericarp of the Scotch rose, a peach-coloured dye is obtained. Fragrant as are the waters distilled from our garden roses, that derived from the eglantine is by many esteemed still more so. The famed rose-water of Egypt is drawn from the white

rose, which is extensively cultivated for the purpose. But more costly, and still more intensely sweet, is the ottar of roses, which is imported from Egypt and the East Indies. To produce it, a cask filled with rose-leaves and water is set in the sun for a few days, when a number of oily particles rise to the surface; these are gradually collected into a scum, which is taken up by means of a little cotton, and squeezed into a phial. It is said that not above half an ounce of this precious perfume can be extracted from 100 lbs. weight of roses.

M. L. D.

THIRD WEEK—WEDNESDAY.

HORTICULTURE.—FRUITS.

Fruits come next to be noticed, and for the facts relating to their history I am indebted to the learned and judicious notices contained in the preliminary observations to the detailed account of the productions of the orchard, published by the Society for the Diffusion of Useful Knowledge.*

The progressive cultivation of fruits, as well as of other vegetable productions, and their removal by wandering tribes of conquerors, from region to region, give, when these events can be traced, a peculiar interest to the subject. The absence of records, and the little attention which early history has paid to almost any thing save the splendid though destructive tracks of victorious armies, has involved the facts in obscurity; but, wherever man has penetrated, we may be assured that he has assisted the dissemination of vegetable productions, "much more surely and rapidly than the birds which bear their seeds from land to land, than the currents of the ocean, or even than the winds."

If we consider, for example, the fruits of our own

* Vegetable Substances, pp. 213-222.

country, we shall observe to what extent the conquests of foreign foes have operated in this beneficial manner. Before the invasion of the Romans, the natives of Britain probably possessed no other than the wild fruits of northern Europe, the crab, the sloe, the hazel-nut, and the acorn. The Romans themselves had, but a few centuries before, obtained their principal fruits from Greece, and more eastern countries. It was not till the triumph of Lucullus, that the cherry was transported to Italy from Pontus,* as a memorial of his conquest. In less than a century, the same species of cherry was common in France, in Germany, and in Britain, where the conquerors had introduced it. Thus the cherry, and in all probability, the peach, the plum, the apple, and the pear, are evidences that Britain was once a province of Rome. It is interesting to remark, as a fact in perfect accordance with the ordinary operations of the allwise, but mysterious Governor, who "causes the wrath of man to praise him," that the evils of war are generally mitigated, in the earlier stages of society, by the diffusion of the arts of cultivation. Plutarch, noticing this in the case of Alexander the Great, says, perhaps with some natural exaggeration, that the communications which that conqueror opened up between distant nations, by his progress into India, had more benefited mankind than all the speculative philosophers of Greece. This incidental blessing, however, is only confined to the early ages of the world; and war becomes an unmitigated evil when mankind have advanced in civilization,—an evil, however, to which that very civilization tends to put an end by distinctly exhibiting it in this light.

Another and milder sway introduced new fruits into Great Britain. I mean that of the church. The Monks, after the conversion of the Anglo-Saxons to Christianity,

* From Cerasus, a Greek city on the shores of the Pontus Euxinus, cherries were first brought to Europe by the Roman conqueror in the year of Rome 680, that is, before the Christian era 73: and from the name of this place our word *cherry* is supposed to be derived.

appear to have been the only gardeners; and, in the agreeable relaxations of this profession, they took great delight. While the rude nobles and barons, and their still ruder dependants, wasted each other by mutual depredations, the sacred ground of the church was universally respected; and there the gentle arts of peace found shelter, and were successfully pursued. The venerable Abbey is almost always found situated in some spot remarkable for its fertility, as well as for the beauty of the surrounding scenery. "Even though it has been wholly neglected, though its walls be in ruins, covered with stone-crop and wallflower, and its area produce but the rankest weeds, there are still the remains of the aged fruit-trees, the venerable pears, the delicate little apples, and the luscious black cherries. The chesnuts and walnuts may have yielded to the axe, and the fig-trees and vines died away, but sometimes the mulberry is left, and the strawberry and raspberry struggle among the ruins."

The Crusades, by renewing a communication with the countries of the East, again assisted the diffusion of those vegetable treasures which had been neglected after the destruction of the Roman empire. The monastic gardens owed many of their choicest fruits to the care of those ecclesiastics who had accompanied the expeditions to the Holy Land. A similar result of this taste for horticulture, which existed in European monasteries, seems to have accompanied the transplantation of this corrupted form of Christianity into the new world. "In studying the history of the conquest," says Humboldt, "we admire the extraordinary rapidity with which the Spaniards of the sixteenth century spread the cultivation of European vegetables along the ridge of the Cordilleras, from one extremity of the continent to the other;" and he attributes this remarkable effect principally to the industry and taste of the religious missionaries. In the South Seas, in Southern Africa, and in Australia, the same system is now pursued; in the two former places, chiefly

by missionaries: in the latter by the free settlers. With regard to Australia, in particular, the introduction of European fruits, and other vegetable productions, was essential to the subsistence and comfort of the inhabitants, for, previous to its occupation by the British, there was scarcely a production of the soil fit for human food; and it is remarkable that the only addition which has been made to the list of our garden vegetables, by the discovery of that new and singular continent, is a species of spinach.

It was not till the age of Queen Elizabeth, that horticulture made much progress among the middle classes. Commerce began at that era to diffuse its wealth, as well as its intelligence and enterprise: and then horticulture may be said to have first exercised its beneficial influences among the mass of the people. In 1596, Gerard published a catalogue of eleven hundred plants, growing in his garden in Holborn, the fruit of much industry and zeal; and, in the reign of Charles I (1629), Parkinson, who may be considered as the Bacon of Horticulture, published his great work. From this period, the science of gardening went hand in hand with commerce and the arts, till it has arrived at its present advanced state. It is still, however, very far from having reached its climax, either in this or any other country. When we reflect, indeed, on the manner in which the powers of nature yield to the hand of the cultivator, and the amazing discoveries, which are almost yearly made, of new and more successful methods of drawing forth her latent energies, we are almost tempted to think that the art of gardening is yet in its infancy. The President of the Horticultural Society, which was founded in 1805, by the exertions of Sir Joseph Banks, and other spirited individuals, thus strikingly expresses himself, in his introductory remarks to the first volume of its Transactions:—"The austere crab of our woods has been converted into the golden pippin, and the numerous varieties of the plum can boast no other parent than our na-

tive sloe. Yet few experiments have been made, the object of which has been productions of this sort; and almost every ameliorated variety of fruit appears to have been the offspring of accident, or of culture applied to other purposes. We may, therefore, infer, with little danger of error, that an ample and unexplored field for future discovery and improvement lies before us, in which nature does not appear to have fixed any limits to the success of our labours, if properly applied."

THIRD WEEK—THURSDAY.

HORTICULTURE.—ENGRAFTING.

If my readers remember what has been said on the nature of the sap,—its circulation, secretion, and aëration, they will be prepared to understand the principle on which the success of engrafting depends. The sap, it will be remembered, which is the food of vegetables, is nearly the same, as to its chemical properties, in most plants; it is collected from the common soil by the roots, and is transmitted by the vital principle, with the aid of capillary attraction, through every part of the plant; in the buds and leaves, it undergoes its first and great change, being there converted into the proper juice, or, in other words, assimilated to the nature, and rendered fit for the development, of the vegetable to which these leaves belong; and, returning from thence, undergoes all the other operations which the conformation and health of the plant require.

It seems obvious, from this account, that all which is necessary for preserving the vital principle, and developing the peculiar properties of any part of a plant, is, that it should be placed in such circumstances, as that the sap, from a root, may be readily transmitted through it, to a bud or leaf. Now this is precisely what is done in the process of grafting. The engrafter takes a scion,

or branch, of the tree which he wishes to propagate, and, having cut off the top from the growing stock which he intends to convert, he applies the inner bark of the one to that of the other, and binds them firmly in this situation. There are various methods of effecting this, which I shall not attempt to detail; it is enough to know, that if the operation be dexterously performed, and the two trees be of so similar a quality in their cellular texture, as to present no material obstacle to the flowing of the sap, the graft will retain its living principle, the necessary circulation will be completed, the buds of the inserted branch will expand into leaves, and in virtue of the law already mentioned, these leaves will secrete the "proper juice" of the vegetable production to which the scion belongs, and will grow into a tree of the same species and variety, bearing fruit precisely of the same kind as the parent plant from which it was taken.

There are some niceties in the operation, which are of importance to its success, and the nature of which confirm the view I have now taken. In what is called tongue-grafting, for example, it is desirable that the top of the stock, and the extremity of the graft to be applied to it, should be nearly of equal diameter; and both must be cut off obliquely at corresponding angles. A slip, or angular opening, is made in the centre of the stock downwards, and a similar slip in the graft upwards, into the former of which the thin point of the upper half of the sloping end of the graft is inserted; the barks of stock and graft are made closely to unite, and are tied firmly together by means of strands of bass-matting, soaked in water, to exclude the external air; a quantity of clay is then applied over all, which had been worked fine, and mixed with small chopped hay, or horse-droppings; or a composition is applied, of turpentine, bees-wax, and rosin. By these means an intimate union is formed between the graft and the stock, and the flow of the sap, both upward through the cellular texture of the plants, and back again through the inner bark, is facilitated.

Budding, which is also frequently resorted to, is an operation of a similar kind, and depending on a similar principle, the only difference between a bud and a graft being, that the former is a shoot *in* embryo, the latter a shoot fully developed. This is a summer, or autumnal process, being performed from the beginning of July to the middle of August, when the buds for next year are completely formed in the axilla of the leaf of the present year.

The chief object of engrafting is to insure fruit, or other productions of some selected variety. This is particularly important in fruit-trees, the varieties of which, raised from the seed, being very numerous, and by far the greater proportion of which producing crabs, or fruit not esteemed for the table. By this ingenious device, the peculiarities of the vegetative process are subjected to the control of man, and made subservient to his comfort; and it is assuredly not too much to say, that these peculiarities were so contrived by the Author of Nature, as to afford, in this respect, a salutary exercise to human ingenuity.

I shall have occasion again to advert to this curious and useful operation, in various modes of its application; meanwhile I conclude this sketch with the following interesting and pious observations, suggested by the subject of grafting, which are contained in a late deservedly popular work:—"It cannot be unworthy of remark, that a phenomenon so striking as that of the mountain-ash, bearing, instead of its own little sour and unwholesome berries, large, sweet, and nutritious pears, in consequence of engrafting, has given rise to a scriptural metaphor, most expressive of a like change in our moral nature, one that is as true, in point of fact, as certainly accomplished by appointed means, and as beneficial in its effects, comparing the fruits of the old nature with those of the new. It becomes not immortal beings to admire the one mystery, and to overlook the other. It becomes not me to tell a fellow-creature the remarkable art by which his

trees may be fruitful, without reminding him that he is himself a tree to be engrafted; and it becomes neither him nor me to study the fruits which we shall gather, without considering the fruits which we bear. May we, who are gardeners in the Lord's vineyard, be wise in the heavenly art, as well as in the earthly; that we may see around us the blossoms and fruit of the engrafted word, which is able to save the soul; and may we give ourselves earnestly to the work, lest the Lord of the vineyard cut down our trees, because, when he came and sought fruit thereon, he found none." *

THIRD WEEK—FRIDAY.

HORTICULTURE.—THE GOOSEBERRY AND CURRANT.

There is no fruit of the British garden or orchard equal to the strawberry for fragrance of flavour, or to the gooseberry for utility or general acceptance. The gooseberry, and its congener, the currant, are indeed the vines of the north; and it is a new instance of paternal care, that this substitute should have been afforded to our climate, for the delicious grape of warmer regions. Viewed in this light, it is a curious fact, that these fruits, and especially the gooseberry, just begin to acquire their good qualities when the grape, in the open ground, begins to degenerate. In the southern provinces of France, for example, where the vine is successfully cultivated, the gooseberry produces fruit scantily, and of no value; and in the north of that country, and more especially in the counties of England adjacent to it, where the vine is niggardly of its produce, the gooseberry grows luxuriantly, and acquires an agreeable taste, which increases as it extends northward.

The history of the gooseberry is little known. If it

* Paterson's "Manse Garden," p. 111.

be not a native of Britain it has, at all events, been long naturalized here, and it nowhere thrives better. In the reign of Henry VIII. it was familiarly known in this country as a garden plant, as appears by the following distich of Tusser, a writer on husbandry, who lived at that period :—

> " The barberry, respis,* and gooseberry too,
> Look now to be planted, as other things do."

This plant may be said to be the solitary fruit of the labourer's garden, in the northern parts of our island; and to him it affords a wholesome and grateful luxury. In Lancashire it is eagerly cultivated by the manufacturing population, and the people vie with each other in the successful production of this fruit. It is, however, more to the size than the flavour of the gooseberry that their attention is directed, because this is the most palpable, though assuredly not the most agreeable quality, the taste usually becoming less rich as the size increases.

" The Gooseberry Shows of Lancashire, Cheshire, Staffordshire, Warwickshire, and other manufacturing counties, are conducted with great system; and an annual account of them, forming a little volume, is printed and published at Manchester. The heaviest gooseberry, which appears to have received a prize, was exhibited at the Shakspeare Tavern, Nantwich, in 1825; it weighed 31 dwt. 16 grains.† The prizes given on these occasions are adapted to the manners of the homely people who contend for them, being generally either a pair of sugar-tongs, a copper tea-kettle (the favourite prize), a

* Raspberry.

† The gooseberry plant, under favourable circumstances, will attain a considerable age, and grow to an immense size. At Duffield, near Derby, there was, in 1821, a bush, ascertained to have been planted at least forty-six years, the branches of which extended twelve yards in circumference. At the garden of the late Sir Joseph Banks, at Overtonhall, near Chesterfield, there were, at the same time, two remarkable gooseberry plants, trained against a wall measuring each upwards of fifty feet from one extremity to the other.—*Hort. Trans.* vol. v.

cream-jug, or a corner-cupboard. The proceedings of these contests, and the arrangements for future years, are registered with as much precision as the records of horse-racing; and doubtless the triumphs which are thus handed down to the colliers' or the weavers' children, by the additions which the goodman makes to his household ornaments, are as deeply valued as the 'gold-cups of Newmarket.'"*

The moral effect of the cultivation of the gooseberry, in the manufacturing districts, is spoken of with approbation in the "Library of Entertaining Knowledge," and most certainly such an agreeable relaxation is unspeakably preferable to the degrading vices to which the population of these crowded parts of the country are addicted. If the healthful occupation of the garden withdraws the manufacturer from the corrupting habits contracted in the tavern, much is gained, at least of a negative nature, in preserving his morals; and doubtless something positive also, in opening and enlarging his mind, and promoting his domestic enjoyments. The prize-shows, however, are of a more doubtful character. If they tend to foster vanity, and excite any thing of the spirit of the *turf*, all that can be said of them is, that they are at all events, a hundred-fold less pernicious than those favourite but most demoralizing amusements of their superiors, to which they have been compared.

The effect of the competition, above alluded to, on the gooseberry itself, is very conspicuous, but not entirely advantageous. It has, as I have already hinted, turned the attention of cultivators from the superior qualities of the fruit to its superior dimensions. In the fruit catalogue of the Horticultural Society of London, there are nearly 200 different kinds enumerated, of which no fewer than 150 are the Patagonian gooseberries of Lancashire.

The varieties of the gooseberry may be said to be almost endless, being propagated by seeds, the produce of which is not only affected by soil and climate, but is

* Vegetable Substances, p. 269.

very various in itself, perpetually appearing in new kinds. The following, however, may be taken as a general description of the qualities, so far as they are associated with colour. The yellow are of a more rich and vinous flavour than the white,—the white than the green. The red are very various in flavour, but are commonly more acid than the others, though to this latter remark there are many exceptions. From this description, it follows that the yellow are most proper for the desert, as well as for being fermented into wine, while the red make the most agreeable preserves.

The currant is perhaps also a native of this country, although it has been regarded as the degenerated grape of Corinth, from which circumstance it derives its name; and, indeed, there is a small seedless grape, in the Levant, which is known by the same appellation, and from which it is possible that it may be derived. In "Dodoen's History of Plants," translated in 1578, it is called "the red beyond-sea gooseberry." There are three distinct varieties of the currant,—the white, the red, and the black, differing from each other in flavour as well as in colour, and each possessing some valuable characteristic qualities. The black currant, especially, has distinguishing peculiarities; its flavour is wilder than that of the other two, and it is supposed to be particularly salubrious, and even medicinal.

I have already adverted to the providential arrangement by which the gooseberry has been made to succeed the vine in our comparatively northern regions; and the same view has been so well expressed by an excellent writer, that I shall conclude this account in his words. "Divine bounty is equalized to the nations. Italy has the grape; but there the gooseberry will not grow, or it will live only as an evergreen shrub, incapable of producing fruit; and it is further pleasant to observe, that, in the large field of the world, proper to the cultivation of our vine, its annual produce is less precarious than that of any other tree,—a further proof that the things

which are really best for man, are also the most abundant and the most easily produced. Were the pine-apple, which sells at one guinea per lb., as easy to be had as the potato or the gooseberry, no family would ever have done with the physician."*

THIRD WEEK—SATURDAY.

HORTICULTURE.—THE ORCHARD.

THERE are fruit-bearing trees, as well as plants and shrubs, which man has appropriated to himself. Of these there are chiefly two kinds,—those which have their seeds inclosed in an edible, fleshy, or succulent substance, and those which, along with a similar substance, have their seed also protected by a stone. Of the former kind are the apple and pear, of the latter the plum and cherry.

The history of fruits is not less curious and interesting than that of vegetables; but I must hasten to other subjects, and shall compress, within a single paper, all that seems necessary, in this place, to say regarding them. Most of our European fruits seem to have had their native place in the East; and among these may be named the apple and the pear. Of both these fruits there are very numerous varieties, the Author of Nature having in this, as in other departments of the vegetable world, left much to the power of cultivation, in conformity to that beneficent law which calls forth industry and ingenuity, by rewarding their labours. Between the wild crab and some of our finest garden apples, the difference is immense; and the same may be said of the sloe and the plum; while this difference is chiefly to be attributed to cultivation, which selects and cherishes the most useful kinds.

The apple was common in Syria in the days of Solo-

* Paterson's "Manse Garden," p. 113.

mon, who, in his Song, as well as in the Proverbs, speaks of it with approbation; but it seems to have been rare in Rome, even so late as the days of Pliny. When, or under what circumstances the art of engrafting fruit-trees was introduced, is not known; but it must have been familiar in Judea in the age of the Apostles, as St Paul draws one of his remarkable metaphors from this source.* I am not aware that it is any where mentioned at an earlier date; and it would appear to have been but partially known in Italy still later, as Pliny notices the art in terms of admiration, which seem to imply that it had been but recently practised. To this art we owe the facility of propagating particular sorts, and these have lately multiplied to a remarkable degree. The varieties of apples at present known are upwards of a thousand, and of pears the fruit catalogue of the Horticultural Society names about six hundred kinds. From both of these fruits an agreeable fermented liquor is obtained.

Of stone fruits, the plum and the cherry are the only kinds extensively cultivated in this country; but the peach, the nectarine, and the apricot are also reared on the walls of our gardens, although these delicious fruits are too delicate for open exposure as standards in this northern climate. Both the plum and the cherry are natives of Europe, though the finest kinds of each seem to have been brought from Asia, that original depository of almost all the most valuable vegetable stores of the world. The former seems to have been introduced into this country as early as the fifteenth century, the latter about the time of Henry VIII.

In tracing the history of fruits, it is remarkable to observe their connexion with the progress of civilization. As our taste refines, and our wants accumulate, the means of gratifying them are extended; and this is doubtless a wise provision of the Creator, by which the stimulus to exertion is kept up, and man finds himself in this, as

* Romans, 11th chapter.

in other respects, in the midst of a wide and constantly increasing field of enterprize, in which he never ceases to achieve new triumphs for his genius and talent. While the sense of taste is a singular and important gift, the means which have been provided for its gratification form a very pleasing department of study, in considering those adaptations, which subsist between the vegetable and animal worlds, and which afford an undeniable proof of Creative intelligence and goodness. It is by their organ of taste, combined with that of smell, that the lower animals distinguish and select their food. What precise kind of sensation this organ produces among them, or whether or not it be similar in different orders, it may be impossible to determine; but that, while it, in some respects, differs from the human sensation, it is decidedly of a pleasurable nature, there can be no doubt. To them, indeed, the pleasure of taste forms the chief charm of existence; and it is beautiful to observe in how many ways the Creator has contrived to prolong the enjoyments derived from this source. Among these, the provision which is bestowed upon ruminating animals of chewing the cud is not the least remarkable. They thus are enabled to enjoy the pleasure of eating a second time; and the latter pleasure is probably more delightful than the former. It is impossible to see a herd of cattle lying on a sunny meadow, amidst the luxuriant herbage they have been cropping, quietly and at their ease re-masticating their plentiful meal, without being convinced that the spirit of enjoyment rests on them; furnishing a new evidence of that Divine benevolence which, notwithstanding the disorder of a fallen world, is so remarkable a feature in the character of the Author of nature, as reflected from his works.

But a far more refined and varied pleasure, arising from the sense of taste, is enjoyed by man. The lower animals, indeed, show preferences in the choice of their food; and the greediness with which they devour one kind of vegetable production rather than another, proves

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that they are capable of degrees of enjoyment, according to the peculiar flavour of their food. But this exists only to a limited extent, and seems to be bestowed chiefly, if not exclusively, as an instinct distinguishing between what is more or less salubrious. In the human species it is different. It is not so much instinct as experience and habit which regulates the choice of his food; and among articles of subsistence equally wholesome, there are great diversities as to what is palatable or otherwise. The truth is, that his taste, as I have already hinted, is obviously intended as a stimulus to his active powers, as well as a source of varied enjoyment; and to accomplish this double purpose, he is furnished with a palate delicately alive to the perception of differences in flavour and pungency. Adapted to this palate are the various vegetable productions with which he is surrounded, or with which he can furnish himself, so diversified in their qualities and modes of existence, as well as in their manner of affecting his taste, and in the degree of enjoyment which they afford. It is striking to run over the numerous productions even of our common gardens and orchards with these considerations in our view, and to think of the roots, the tubers, the bulbs, the broad juicy leaves, the farinaceous seeds, the fleshy and succulent fruits, with their almost interminable varieties of fragrance and flavour, of sweetness and acidity, of mellowness and pungency, all so wonderfully suited to gratify the taste, and stimulate the appetite. If we look beyond our own country, and think of the vegetable produce of other climes, we find the catalogue wonderfully increased, and discover still more reason to admire the diversified resources of nature, and the peculiar sensitiveness of the human palate, which can so accurately distinguish, and with so much relish appreciate, all that is exquisite in these diversities. The east, the west, the north, and the south, all furnish new and agreeable means for the gratification of his sense of taste; and in the varied sensations to which these varieties give rise,

new departments are opened of commercial activity, discrimination, and enterprise.

That this extensive and curiously varied system of edible vegetation has been constructed for wise purposes, we might, *à priori*, be entitled to conclude from considering the wisdom which appears in every other department of nature. That its effects are practically useful, and admirably adapted to the circumstances and character of man, will be obvious if we consider what the effect would be of a different system. Let any man, for a moment, imagine to himself what consequences would arise from the human palate being formed with the obtuseness of that of the brutes. I do not speak of the sensual enjoyment which we would thus lose, for that, to a right constituted mind, is little. The Scottish cottager, in his frugal repast of potatoes or of prepared corn, may feel as much real content, and as substantial a pleasure, as the gourmand, surrounded with all the luxuries of the table. But I refer to the effect that would be produced on the human community. Those who are aware of the workings of society, will scarcely think it too much to say, that had not the nice perceptions of the human palate been bestowed, a vast stimulus to mental and bodily exertion would have been wanting, which, to say the least, must have most materially interfered with the advancement of mankind in the race of civilization.

The recent transportation of fruits from one region to another, has been very happily employed by Hume to prove the comparatively late origin of the human race, and may certainly serve, though he meant it not, as a collateral argument in favour of the Mosaic history of our globe.

"Lucullus was the first," observes he, "who brought cherry-trees from Asia into Europe; though that tree thrives so well in many European climates, that it grows in the woods without any culture. Is it possible, that throughout a whole eternity, no European had ever

passed into Asia, and thought of transplanting so delicious a fruit into his own country. Or if the tree was once transplanted and propagated, how could it ever afterwards perish?" He makes a similar remark as to the vines of France, and the corn and animals which have been transplanted within these three centuries to America; and then he adds, "all these seem convincing proofs of the youth, or rather infancy, of the world; as being founded on the operation of principles more constant and steady than those by which human society is governed and directed. Nothing less than a total convulsion of the elements will ever destroy all the European animals and vegetables which are now to be found in the western world."

This subject cannot be presented with the same precision as the geological inquiries of Cuvier; but, assuredly, the circumstances alluded to have a tendency to confirm his argument in favour of the fact, that the present surface of the earth is not of more ancient origin than the period assigned in the Inspired Volume to the deluge; and thus, the vegetable and animal productions of our globe speak the same language as the soil on which they grow, and raise their united voices to confute the sceptical arguments of the infidel.

FOURTH WEEK—SUNDAY.

SPIRITUAL SOIL.

Leaving out of consideration the influence of climate, the growth of vegetables depends, partly on the quality of the seed, and partly also on the nature of the soil, and its state of cultivation. The same thing may be said of the growth of spiritual life in our hearts; and our Saviour, in his beautiful parable of the Sower, has very strikingly described the different reception of Divine truth in the minds of hearers of different characters, by alluding to this analogy. The preacher of the Gospel is represented as a sower scattering the seed of God's word. It is precisely the same seed which is sown, possessing in itself the same living qualities; but the soil is various, both as regards natural fertility, and careful preparation.

Those who hear the message of salvation without any emotion, are compared to a wayside, hardened by the treading of many feet. First have moved, unresisted, over the heart, a host of evil inclinations, to indurate the soil; then, crowding in the same track, have passed a long train of wicked examples; and then comes habit, with its stiffening influence, to complete the evil, and to render the labour of the spiritual husbandman vain. The seed is sown, but it penetrates not that beaten soil. It lies uselessly on the surface, till "the fowls of the air come and devour it up." It is impossible to look abroad over the face of the Christian world, and not to be sensible that there are many who thus receive a preached Gospel. They join a congregation with hearts which the world has rendered callous and hard, and they listen to the truths of the Gospel without any desire to profit by them. To them the Sacred Volume unfolds its treasures of divine knowledge in vain. It speaks of human guilt,

but it moves them not, although their own bosoms echo back the awful truth; it whispers mercy to the believing and trembling sinner, but them it moves not. It speaks of an offending Judge; it speaks also of a reconciled Father; but neither by hope nor by fear, by awe nor by affection, are they moved. They are told of the wonders of redeeming love, and the unspeakable grace of a crucified Saviour; yet they hear it all as an often-repeated and tiresome tale, in which they have no personal interest; and with closed eyes, and shut ears, and consciences seared, they run recklessly to destruction. It is the god of this world who catches away the seed as it falls; and thus the very means of grace,—the very ordinances of the Gospel, become a snare to their souls.

These are the totally careless and indifferent; but there are others, whose situation is scarcely less hopeless, and yet they are religious professors. These are, in the parable, compared to the stony places, on which the seed falls from the hand of the sower. Here the young blade springs up suddenly, because there is no deepness of earth; "but when the sun is up, it is scorched, and because it has no root it withereth away." This forcibly describes those sentimental hearers, whose feelings, being susceptible, receive hasty and ardent, but fleeting impressions of religion. Their hearts overflow, and their eyes weep, when they think of their Saviour's sufferings. They tremble under the terrors of offended justice, and they exult in the hope of salvation, as the preacher sets before them alternately the threatenings and the promises of the Gospel. But there is no depth in their feelings; there is no solid foundation in their religious character. With the very same levity with which they were incited by the eloquence of the preacher, to weep and to rejoice, they are induced, under other circumstances, to neglect their religious duties, or even to abandon their religious principles. These "have no root in themselves," and hence they only "dure for a while."

It is a frequent and fatal mistake to separate religion from the duties of active life. The test by which we ought to examine the genuineness of our faith,—by which we should try the strength and stability of our religious principles, is the effect produced on our conduct in the intercourse of society. In the day of trial, have these principles sustained us? In our combats with an evil world, have they brought us off victorious? Amidst the seductions of passion, and the temptations of evil example, and the ridicule of the profane, have we stood firm as a rock, looking to Jesus, trusting in God, triumphing in the hope of immortality? These are questions, by which we may discover how far we are removed from the character of those whom the parable describes under the figure of stony ground, in which the seed springs up and dies,—whose religious feelings, lying too near the surface of their character, prove to be nothing more than a hasty, vain, and deceitful show.

But there is still a more common character among hearers in a Christian congregation,—those whom our Saviour compares to a soil overgrown with thorns, which, though cut down, have not been rooted out, and therefore spring up along with the seed, and choke its growth. Those who possess this character, differ from the callous and indifferent in this, that they "hear the word;" it makes some salutary impression on their mind: And they differ from the sentimentalists in this, that they are not betrayed by the ardour of a heated imagination. They have soberly studied the evidences of Revelation, and their judgment is convinced. They believe that the Bible is the word of God, they acknowledge its importance, and they are resolved, at some future "more convenient season," to devote themselves to the service of their Redeemer; but at present they are immersed in the cares of the world, and subjected to the influence arising from the real importunity of these cares, and their fancied magnitude. Perhaps they are in straitened circumstances, and they make sheer necessity their ex-

cuse for devoting themselves to worldly objects; or, if they are in affluence, wealth, as well as poverty, brings with it many employments and many cares; and not less easily does the worldly mind, in this instance, find plausible excuses for neglecting the calls of religion. The difficulty, however, does not, in either case, really lie in want of opportunity to devote themselves to the service of their Divine Master; but in want of inclination. They are "cumbered about many things," and forget that there is only one thing peremptorily and essentially needful. They take anxious thought only about "what they shall eat and drink," or how they may best obtain and enjoy the pleasures of life. But if they were to "seek first the kingdom of God and his righteousness," and then apply, as a subordinate object, to the gaining of a provision for their families, Christ has himself declared, that this earthly blessing would be added to them; and unless they seek first the kingdom of God and his righteousness, all the leisure and opportunities which may be afforded them, will be unavailing. The "good seed" will still fall among thorns, which will choke its growth, and render it unfruitful.

How thankless,—how heartless,—were the labours of the spiritual husbandman, if it were always thus,—if, after all, no fruit were to crown his toil! But, blessed be God, it is not so. Some seed also falls on good ground,—on ground, indeed, naturally overgrown with weeds, and therefore incapable of receiving it; but so prepared by previous culture, as to retain and nourish it, and, under the genial influences of Heaven, to bring the fruit to maturity. It is thus prepared by the hand of God himself;—no inferior hand could successfully prepare it.

And let it further be remarked, in following out the analogy of the parable, that whatever pains an agriculturist might take in cultivating his farm, it could never be made to produce a crop of itself. It would, after all, remain unproductive, without the genial influences of

the seasons. The sun must smile upon it, and the clouds must interpose their grateful shade, to protect it from the sultry heat; and the dew of night must rest upon the tender blade, and the soft showers of heaven must bless the springing thereof. It is God who, with his own hand, "covers our valleys with corn, and causes them to shout for joy." Just so it is in the spiritual world. Not only must our hearts be prepared, and the seed of the word sown in a good soil; but Heaven must shed its blessed influences from above; and the Sun of Righteousness must shine upon it; and the warmth of heavenly love must cherish it; and the dew of Divine grace must distil upon it; and even the clouds of adversity must frown, and the rain-drops of affliction must water it.

FOURTH WEEK—MONDAY.

PRODUCTIONS OF WARM CLIMATES USED FOR HUMAN FOOD.—THE BANANA—THE DATE.

The productions of tropical regions are much more luxuriant than those of the temperate zone; and such as are employed for the support of human life, are both more numerous, and naturally more abundant. They require less of the arts of cultivation; and it is no slight or equivocal proof of wise adjustment, that, in a climate where the excessive heat precludes hard and incessant toil, the food of man should be almost spontaneously provided for him. The consequence, however, is, that the human family have their faculties less vigorously developed in this than in cooler climates.

Of roots, there are, among many others, the cassava, the arrow-root, the batata, the yam, and the aracacha. Of vegetables, rice, maize, millet, kidney-beans, and various kinds of pulse may be particularized. Among trees there are the orange with its varieties, the tamarind, the banana, the cocoa-nut, the bread-fruit, &c. Besides

these, there are various productions from which, though not articles of food themselves, different kinds of substances used extensively at our tables are extracted, such as the sugar and tea plants, the cocoa or chocolate tree, the sago palm, &c. &c. The spices of these climates, too, where, to use the language of our Scottish bard, "bright beaming summers exalt the perfume," are numerous and delightful; and all these varieties of vegetable productions, calculated to add to the enjoyments, and to promote the commercial spirit of the human race, tend to increase the gratitude of the pious heart to the Giver of all good.

Among such a variety, it is difficult to make a selection; and yet it seems desirable that the vegetable food peculiar to warm climates should receive some notice. Before describing any particular plant, there is one general observation which must not be forgotten, as it is an instance of peculiar and wise adaptation. The vegetable food of tropical regions is constantly intermingled with productions remarkable for their pungency and their acid qualities, in which particulars it differs materially from the food of colder climates. Of this kind are the whole orange genus, the tamarind tree, and the pepper plant. The providential intention of this cannot be mistaken. Acids, having a cooling effect on the animal frame, are peculiarly grateful and refreshing under a burning sun; while the relaxed state of the stomach, when oppressed with excessive heat, requires stimulants, such as pepper and other plants of this nature supply. Adaptations of a similar kind of food to climate are known to prevail in all regions, and are probably more numerous than have yet been ascertained.

The banana is, perhaps, the most useful, universal, and characteristic fruit of the torrid zone, and it may, therefore, be taken as a proper representative of the esculent vegetable productions of these regions. It is remarkable that this plant, like the corn plants of temperate climates, whose place it supplies, is not known in an uncultivated

state. The wildest tribes of South America, who depend upon this fruit for their subsistence, propagate the plant by suckers; and the necessity which nature has thus imposed on them, has raised them to the rank of cultivators, and given them the first rude notions of industrious labour. Eight or nine months after the tree has been planted, it yields its fruit in great abundance; and when this is removed, and the stalk cut, it again yields fruit in three months. Its stalk is herbaceous, and shoots upwards to the height of fifteen or twenty feet, being about five or six inches in diameter at the surface of the ground, and tapering towards the top. The leaves, which are very large, are formed in a cluster at the top of the stem, and in the centre of these the spike of flowers rises to the height of about four feet. From the flowers the fruit forms rapidly; it turns yellow as it ripens, and is filled with a pulp of an agreeable flavour and nourishing quality. It is exceedingly prolific. A spot of a little more than a thousand square yards will contain from thirty to forty banana plants. A cluster of bananas, produced on a single plant, often contains from 160 to 180 fruits, and weighs from seventy to eighty pounds. But reckoning the weight of the cluster only at forty pounds, such a plantation would produce more than 4000 pounds of nutritive matter. Humboldt compares this quantity with that yielded by wheat and potatoes, and calculates that the produce of the banana, in a given space, is to that of wheat as 133, and to that of potatoes as 4 to 1.

The nutritive matter of the banana, however, weight for weight, bears no comparison with that of wheat, or even of potatoes; but its superior quantity far more than compensates for this difference; and Humboldt maintains, that a piece of ground, planted with bananas, will support twenty-five individuals, when a patch of similar extent would support only a single individual, if sown with wheat.

This immense production of food, which seems to be intended to render the regions of the tropics peculiarly

populous, has not yet effected this purpose to the extent which might have been expected. Both moral and physical causes seem to have combined in retarding such natural results. The enervating power of the climate, the debasing influence of tyrannical governments, the depressing effects of caste and of superstition, and the devastations of exterminating warfare, have all doubtless united, in no slight degree, with the sedative operation of a profusion of food obtained with little labour. The happy consequences to the human character of a colder climate, and a more scanty supply of food, have elsewhere been pointed out;* and it was certainly in the temperate regions that the human powers and faculties were destined to be first powerfully called forth and cultivated. But we see operations in progress, which may eventually, and at no distant period, produce a great moral change in the condition of the inhabitants of tropical countries, and thus develope the intentions of Providence in supplying these regions so plentifully with the means of subsistence.

The wide and fertile plains of Eastern India are ripe for an experiment, which will probably have a powerful and lasting effect on the destinies of the world, and will unfold views of the intentions of Providence as to the abundance of tropical food, which have as yet failed to be practically realized. The intelligent inhabitants of Europe have indeed visited and conquered extensive regions between the tropics; but they have either been repressed in their energies by an ignorant, oppressive, and jealous government in the native country, or have only taken up a temporary residence in a region which they regarded as a species of banishment from their native home, while the curse of slavery attended their steps, and blasted their efforts at improvement, demoralizing their own characters, and embittering the days of those brutalized beings who were the objects of it.

A brighter prospect seems to lie before us.—While in

* See "Spring,"—Origin of Agricultural Labour, &c. &c. pp. 249-268.

the torrid regions of America the people have emancipated themselves from the yoke of the mother countries, and are gradually shaking off the corruptions and degradation to which they were thus subjected, the Eastern regions which Providence has placed under the milder and wiser sway of Britain, have been for a number of years preparing for a still higher destiny. The natives, naturally acute, are becoming enlightened by education, and by intercourse with their European masters; the prejudices of caste, and of a debasing faith, are disappearing; and industrious habits are increased and increasing. A monopoly, become useless and burdensome, has been abolished. Our enlightened and industrious island, is about to pour its surplus population on these prolific lands. They will carry with them the activity, the wisdom, the agricultural and commercial spirit of their native country; and, above all, the light and enlargement of its holy religion. They will in that fertile region obey the great law of their nature, without any immediate or sudden check; and while they "increase and multiply and replenish the earth," they will call forth and bring into practical exercise those exuberant powers of vegetation, which seem to be awaiting so auspicious an era. May we not, without being accused of Utopian extravagance, be permitted, under such conditions, to anticipate the time when even the prolific banana tree will not suffice to supply the increasing wants of a dense and flourishing population; and when the hills and valleys of this renovated region will smile under the blessings of varied and grateful fruits; of numerous vegetable productions of other kinds, for food, for commerce, and for manufactures; of herds and flocks; and of industrious men plying their labours in cultivated field and watered meadow. And, to crown the whole, may we not hope that idolatry and superstition will take alarm at the increasing light, and depart; that the huge temples of the horrid Juggernaut will give place to the churches of the living God; and that his bloody

worship will be succeeded by the deep-breathed prayers, the tender affections, and the ennobling hopes and aspirations of the servants of the Prince of Peace. What Christian does not pray for so happy a consummation? What statesman would not think himself honoured in promoting it?

Another family, that of the palm tribes, is very peculiar and important among the trees of the tropical and adjoining regions, productions of this class being justly ranked among the most magnificent and elegant, as well as useful, of the vegetable world. There are numerous varieties, among which the sago palm of Asia furnishes the greatest quantity of nutritious matter; and indeed, next to the banana, it is the most prolific in food of any other plant, a single tree sometimes furnishing, in its fifteenth year, not less than six hundred pounds of sago. It is not, however, my intention to prosecute, at present, the inviting subject of tropical fruits; but the peculiar properties and habits of the date-palm require some notice.

This singular tree cannot properly be said to belong either to the tropical or the temperate regions, its natural locality being regulated by other circumstances than climate, while a very considerable degree of heat is necessary for the development and ripening of its fruit. The date is, in the vegetable world, what the camel is in the animal; and, being a native of the same regions, it seems indeed intended as its companion and co-adjutor, in rendering fit for the habitation of man, a very peculiar portion of the globe, which would otherwise be forlorn and desolate. That region constitutes the extensive district which lies between the confines of the Persian Gulf and the Atlantic Ocean, stretching to the extent of nearly four thousand miles, and possessing, from some peculiarity of cosmical circumstances, which is not very clearly understood, the disadvantage of want of moisture in the atmosphere, which causes great aridity in the soil, and renders it unfruitful. The consequence

of this state of things is the existence of the great Sahara, or desert of Africa, and the wide-spread wilds of Arabia. For what purposes Divine Wisdom has formed so extensive a region of desolation, or whether it may yet be reserved for the industry and ingenuity of man, to render it habitable by means of Artesian wells, and other resources of art, it may be difficult to conjecture; but what I have at present to remark is, that we have here compensations and contrivances to mitigate the evil and contract its extent, analogous to the character of the Divine dispensations, where other apparent defects occur. The chief of these are to be found in the peculiar properties of the camel and the date-tree,—the latter being intended to supply human beings in these otherwise barren regions, with substantial and agreeable nourishment, the former to furnish them with a most useful servant, admirably adapted to the wants of the locality.

Of the camel I have elsewhere spoken,* when adverting to the adaptation of organized existences to the peculiarities of climate;—the date-tree serves equally to illustrate the same providential provision. Of the district we are now considering, there are particular spots and lines of great fertility, especially along the shores, and on the banks and deltas of the rivers; of which latter description Egypt is a well-known instance. Wherever there is humidity, indeed, from any cause, throughout the whole extent of this region, there Nature exhibits in great vigour her prolific powers;—but along the verge of the desert, and in the smaller oases which here and there relieve the dreariness of the wilderness, the date-palm is the only vegetable on which man can subsist. The more lowly plants on that soil are chiefly of a saline description, such as euphorbias, salsolas, and cactuses, which retain their own humidity in consequence of their smooth and close rhinds, without much aid from external moisture; but their juices are in general too

* "Winter," pp. 73, 74. Third Edition.

acrid, or too much impregnated with soda, for being used as human food. Over these the date-palm raises its trunk, and spreads its leaves, and is the sole vegetable monarch of the thirsty land. "It is so abundant, and so unmixed with any thing else that can be considered as a tree in the country between the State of Barbary and the Desert, that this region is designated as the land of dates; and upon the last plain as the Desert is approached, the only objects that break the dull outline of the landscape, are the date-palm and the tent of the Arab. The same tree accompanies the margin of the Desert in all its sinuosities; in Tripoli, in Barca, along the valley of the Nile, in the north of Arabia, and in the south-east of Turkey."*

There is hardly any part of the date-tree which is not serviceable to man, either as a necessary or a luxury, resembling in this respect the cocoa-nut tree, described in a previous volume.† When the fruit is completely ripened, it will, by strong pressure, yield a delicious syrup, which serves for preserving this and other fruits. The stalks of the bunches, as well as the kernels, are softened by boiling, and in that condition are used for feeding cattle. The conical tuft, in the centre of the crown, called the cabbage, formed of the future leaves, in their undeveloped state, is an agreeable esculent, resembling the chesnut in flavour; the fibrous parts of the tree, as well as the strings, or stalks, that bear the fruit, are made into ropes, baskets, mats, and various other articles of domestic use. The cordage of the ships that navigate the Red Sea, is manufactured from the inner fibrous bark of the trunk. The trunk itself is converted into supports for the huts and tents of the natives, while the pith or medullary substance is partly farinaceous, and may be used as food, resembling the sago extracted from another species of palm.

It is worthy of remark, that a variety of this tribe is

* Vegetable Substances, p. 350.

† "Spring"—paper on the Dissemination of Plants, p. 293, &c.

found in a similar locality as to soil and climate, on the coast of Coromandel, in the peninsula of Hindostan. This is a great leafy bush, the trunk of which is not more than a foot and a-half or two feet high, entirely covered by the drooping leaves. The pulp of its fruit is sweet and mealy, and the farinaceous matter contained in the trunk is abundant, but on account of its bitterness not very palatable. It is, however, gladly resorted to in seasons of scarcity, and has often saved the inhabitants from all the horrors of famine.

How curious are the arrangements of Providence; and how improving to the mind to trace their endless varieties. There are many things, indeed, as we have frequently had occasion to observe, the reasons of which seem to be beyond the powers of human research; but even in these, or connected with them, the inquirer finds compensations and adjustments, which clearly indicate designing Intelligence; and, while they irresistibly impress us with the conviction that the hand of God is there also, fill us with an assured confidence that even in what appears to our limited view deformity or defect, there is a hidden wisdom which will be developed in the course of ages, or, at all events, will burst on our admiring view, when we no longer "see as through a glass darkly."

FOURTH WEEK—TUESDAY.

TREES USED FOR OTHER PURPOSES THAN FOOD.

We have seen what a vast variety of vegetable productions have been destined to be used as human food, adapted to all soils and climates, and capable of great increase and amelioration by culture. In this we have had occasion to recognize and adore the paternal care of an all-bountiful Creator. But it is not with a view to subsistence, and the gratification of taste alone, with the

concomitant stimulus given to the exercise of the bodily powers and mental faculties, that a Father God has bestowed the vegetable stores with which we are so profusely surrounded. These, indeed, are gifts of primary importance. But there are other provisions of no mean value, to which the productions of the vegetable kingdom have been made subservient. In the volume on Spring, I have adverted to various plants, used as articles of manufacture; but I have hitherto only incidentally taken notice of the uses, either in this or other respects, to which trees are applicable. These seem now to require some attention.

The first thing after food and clothing, to which man naturally looks, is a comfortable habitation, and for this he is mainly indebted to the trees of the forest. Even in his rudest state, it is among these that he seeks shelter, and as he gradually emerges to a higher grade, it is to the timber which they yield that he is indebted for his most useful materials, in constructing the lofty palace as well as the lowly cot. His implements of domestic life, and his instruments of husbandry, are from the earliest to the latest period of human improvement, essentially indebted to the admirably adapted material afforded by trees. For the machinery used in commerce and the arts, timber is equally essential; and, above all, it is to timber that we owe the power of sailing, by which the dispersion of human beings over the surface of the habitable globe has been effected, and that intercourse has been kept up which has contributed so largely to the advancement of commerce, and the arts and comforts of civilized life.

It would be a curious subject of speculation to inquire what would be the character and condition of man, had it pleased Providence to withhold from him the advantages derived from trees, merely regarding them as affording the useful article of timber. Into this speculation, however, I shall not at present enter, further than to observe, that, as it is doubtless, by the possession of

a material applicable to so many important, and indeed necessary, purposes, that man has been enabled to carry into effect almost all his plans of utility, of convenience, or of luxury, as far as they have depended on the use of physical instruments; so, with it, talent and genius would have been most materially stinted in their means of action, and therefore in their growth; and although the human race might still have existed, they would have remained circumscribed in their locality by the extent of the island or continent where they were first called into being, with views unenlarged and faculties unemployed. They would, in short, have been wild and unenlightened savages, rising, in all probability, no higher in the scale of existence, than the depressed Greenlander, or miserably degraded native of Australia. We have here another instance, to show that man depends for the improvement of the powers bestowed on him by his Maker, on the adaptations of external nature to his mental capacities; while to these capacities the necessary adaptations have been most strikingly made.

The varieties in the qualities of timber, by which it is made subservient to the diversified purposes of man's necessities or ingenuity, is another subject of grateful admiration. The strength and durability of the oak, so admirably calculated for ship-building; the straightness, the elasticity and lightness of the pine, united with the ease with which it yields to the moulding hand of the joiner, pointing it out as peculiarly useful in the construction of houses; and the remarkable combination of all these properties in the ash, which renders it, in an especial sense, the husbandman's tree,—are specimens of this accommodation, which may suffice at present, as, in another volume, I shall have occasion to resume the subject.

But besides the uses of trees for timber, whether as these respect necessity, convenience, or ornament, there are many other valuable properties possessed by different species of this class of the vegetable world. I have

already spoken of the fruits, and other substances which they yield for the food of man; and I might also have mentioned their qualities in this respect, as regards some of the lower animals, and especially several of the insect tribes, to whom the leaf, the flower, the seed, the bark, and even the wood and pith, furnish each their own peculiar nourishment, and different tribes of which are useful to man.* But the bounty of the Creator is not less conspicuous in having by the same means provided various other peculiar substances of essential use in the arts. Of this nature is the principle of tannin, residing in the bark of the oak, the larch, and very many other trees, so remarkable for its preservative qualities; the galls, extracted from an excrescence on the oak, produced by the puncture of an insect, for the purpose of depositing its eggs; the tar and turpentine manufactured from the pine; the various kinds of dye produced by the quercitron, the Brazil wood, the hiccory, the walnut, and the birch; the wax of the Brazilian and Andes palms; the tallow of the croton and piney trees; the gums from the acacias of Arabia and Senegal; the odoriferous gum resins from several trees of the East; besides numerous medicinal extracts, which add to the materia medica of all civilized nations.

These varied uses of trees form each a new example of Creative beneficence; and were it not necessary to hasten to other matters, it might be advisable, as it certainly would be interesting, to enter with some minuteness into the nature of the provisions by which such productions are elaborated. The subject, however, is far too extensive to make this compatible with our plan; and I must be satisfied with a distinct notice of only a few kinds of produce of the most general utility and importance. These will occupy some succeeding papers; and, mean-

* Of this latter kind is the *coccus ilicis*, gathered in Spain from a species of dwarf oak, called Kermes, producing a beautiful scarlet dye; the silk-worm, which receives its nourishment from the leaves of the mulberry; and the worm which the native Australians find in the pith of a tree of that country, and which they eagerly devour.

while, I must call upon my readers to remark once more the astonishing exuberance of Divine bounty in the diversified properties of the substances produced in the vegetable world, for human uses in the arts of life. I have already noticed a similar variety in the articles of food; and it cannot be doubted that the intention, in both instances, is the same; namely, to call forth, and afford a salutary excitement to the mental faculties, as well as to keep th. bodily powers in healthy exercise. In both instances, too, the climate and localities so far separated from each other, and spreading indeed over the whole extent of the globe, through which these varieties are scattered, are additional examples of wise contrivance, by which social and commercial intercourse is promoted, and the whole human family are united by mutual ties of interest, which have already produced many happy effects, and seem destined rapidly to produce still more. The present aspect of the civilized world is, indeed, in this respect, peculiarly encouraging, and seems to hold out the most delightful anticipations to the Christian philanthropist.

FOURTH WEEK—WEDNESDAY.

VEGETABLE SUBSTANCES USED IN TANNING.

The art of tanning the skins of animals is of very remote antiquity. Pliny attributes the invention of leather to Tychius of Bœotia. But though so ancient, this art has only of late been brought under the consideration of scientific men, having been merely pursued by practical persons technically acquainted with its various processes.

In England, the bark of our native oak originally furnished the only substance for the tan-pit; and this material, after it had served its purpose, was then thrown out as useless. It was said that William the Third first turned the attention of English gardeners to its value

for horticultural purposes, having imported the practice from Holland. Its useful qualities, however, in producing artificial warmth in hot-houses, though now generally recognized and employed, were little understood in this country for many years after the period of the glorious Revolution.

About a century ago, no practical man in this country suspected that the tanning principle resided any where except in the bark of the oak; and nothing was known of the principle itself, except that it possessed the power of preparing leather for use, and preserving it from decay. The growing scarcity of the material, about this period, led to an inquiry into the subject, and it was discovered, that, so far from this useful quality peculiarly belonging to the oak, it was common to many other plants, and that in other places, people availed themselves of this knowledge. Heath pulverized, gall-nuts, and the bark of the birch-tree, were found to be used in Germany; myrtle-leaves, in some parts of Italy; laurel-leaves in Corsica; the bark of the willow, in Russia; tormentil-root, in St Kilda; the bark of the red mangrove-tree, in the West Indies.

M. Seguin, an excellent practical chemist, turned his particular attention to the principle of tanning, and published his experiments and discoveries in 1756, which threw on the subject the light of science. He found that there was a quality inherent in many vegetables, to which he gave the name of *tannin*, and on which the preservative powers of the process of tanning depend. The extract which he called by this name, is a brittle substance, of a brown colour; it breaks with vitreous fracture; does not attract moisture from the air; and is extremely astringent to the taste.

The hides of animals, when divested of the hair and epidermis, consist wholly of gelatin, a substance soluble in water, and forming, when combined with it, the well known jelly called glue. Tannin is likewise very readily dissolved in water; but, by a chemical change, the

analogy of which is by no means uncommon, a union of the two forms an insoluble imputrescent compound; and hence the efficacy of tannin in the preparation of leather.

The attention of scientific men being led, by these discoveries, to this curious and interesting subject, it was speedily found that tannin abounds in the vegetable kingdom. Sir Humphrey Davy, after a careful investigation of the subject, was led to the conclusion, that, in all substances possessed of the astringent taste, there is reason to suspect the presence of tannin; and that it even exists in substances which contain sugar and vegetable acids. "I have," he adds, "found it in abundance in the juice of sloes; and my friend Mr Poole of Stowey, has detected it in port wine."

Various experiments have been made with the view of ascertaining the relative quantity of tannin in different vegetable substances. It is intimately connected with the mysterious processes of vegetable secretion; and Mr Biggin found that similar barks, when taken from trees at different seasons, differ greatly as to the quantity of tannin which they contain. More than four and a-half times greater quantity of tannin was obtained from oak-bark, cut in spring, than from an equal quantity of the same kind of bark cut in winter.* Sir H. Davy observed, that the proportion of the astringent principle in bark varies considerably, according as the age and size of the trees are different. These proportions are, besides, often influenced by accidental circumstances, so that it is extremely difficult to ascertain their distinct relation to each other.

There is another vegetable matter, called by chemists *extractive*, which is absorbed by skins, together with tannin, and which gives them softness and durability; and it is therefore necessary to take this property into account in the process. The leather produced by means of an infusion of galls, for example, is generally found

* Philosophical Transactions for 1803.

to be harder, and more liable to crack, than that prepared by an infusion of barks, from the circumstance of a less proportionate quantity of extractive matter having entered into chemical combination with the skin. It is, therefore, a circumstance worthy of remark, as forming another instance of those wise adaptations which we have so continually occasion to remark in all the operations of nature, that extractive is constantly united with tannin in those vegetable substances used in the preparation of leather, and situated in such close contact* with it, that, in all ordinary operations, they will always be used together, except intentionally separated. They are substances of very different chemical properties, as well as applied to uses altogether different in the vegetable economy; yet they are both of great importance in the operation of converting hides into leather; and the adaptation consists in this, that they *both* exist in the bark; by which arrangement they have, from time immemorial, been used together, without the tanner being at all aware of it. It was only late chemical analysis, indeed, which caused them to be distinguished.

In considering this subject, therefore, with reference to a Final Cause, were we even to grant, which I am very far from doing, that the use of bark in tanning hides, is the mere result of human experience, unintended by the Creator, there still remains the remarkable circumstance I have mentioned, of the conjunction of two unallied chemical properties in the bark, both of them of essential importance to the perfection of the process, with which human reason had assuredly nothing to do.

* "In every astringent bark," says Sir H. Davy, "the interior white bark, that is, the part next to the albumen, contains the largest quantity of tannin. The proportion of extractive is generally greatest in the middle or coloured part; the epidermis seldom furnishes either tannin or extractive matter. The white cortical layers are generally most abundant in young trees, and hence their bark contains, in the same weight, a larger proportion of tannin than the barks of old trees."—*Phil. Trans.* for 1803.

FOURTH WEEK—THURSDAY.

VEGETABLE FIXED OILS.

Vegetable oils are distinguished into two kinds, fixed or fat oils, from which no vapour is given off at the temperature of boiling water, and volatile or essential oils, which give off vapour at or below that temperature with water, or under 320° by themselves.

Those of the first class are obtained by expression, principally, if not entirely, from the fruit or seed of plants. A great variety of seeds are more or less oleaginous, more especially those of the nut kind, from all of which oil may be extracted. Many of the oils of this description are applicable to the arts, or are employed, in combustion, for producing light.

The vegetable oil most known and esteemed, is that expressed from the olive. This tree, which now appears a native of Italy, luxuriating in a genial soil and climate, is not, however, indigenous to that country. Pliny, who largely discourses on the olive tree, and its produce, notices its first introduction; whence Gibbon remarks, "The olive, in the western world, followed the progress of peace, of which it was considered as a symbol. Two centuries after the foundation of Rome, both Italy and Africa, were strangers to that useful plant. It was naturalized in those countries, and at length carried into the heart of Spain and Gaul. The timid error of the ancients, that it required a certain degree of heat, and could only flourish in the neighbourhood of the sea, were insensibly exploded by industry and experience."*

The olive and the cornel are the only trees in which oil is expressed from the pulpy part of the fruit, and not from the seeds or nut alone. The oil obtained from the kernel of the olive, is supposed to become rancid sooner than that obtained from any other part; and, therefore,

* Decline and Fall of the Roman Empire, chap. ii.

in producing the best oil, care is taken that the stones are not cracked in the preliminary process of bruising the fruit: nor are they subjected to such pressure as would produce this effect at first, when the best oil comes over. The press used for this purpose, is of a very simple construction. The fruit having been bruised by the action of a millstone, is transferred to the trough of a screw-press; and, after as much oil is obtained as can be extracted by the degree of pressure given, hot water is poured on what remains in the trough. The whole is then subjected to a stronger pressure, and a coarser product is procured. When all the oil is entirely expressed, the refuse is used as fuel.

The best soap is made of olive oil, mixed with alkalis; but its preparation for this purpose is not so carefully conducted as when it is intended to form an ingredient of food. Spanish soap, known in England as Castile soap, is made with olive-oil, which is also largely used for the same purpose at Marseilles. The heavy duty charged on importing olive oil into this country, viz. eight guineas per ton, effectually prevents its application to soap-making in England.

This oil becomes solid at 10° of Fahrenheit. Its specific gravity is ·913. It is never used in the composition of paints, as it does not dry completely. The olive-tree produces oil abundantly; and a plantation of this in a favourable climate, is always a certain source of profit to the industrious. "The young olive plant," says Maria Graham, "bears at two years old, and in six years begins to repay the expense of cultivation, even if the ground is not otherwise cropped. After that period, in good years, the produce is the surest source of wealth to the farmer; and the tree rivals the oak in longevity; so that the common proverb here is, 'If you want to leave a lasting inheritance to your children's children, plant an olive.' There is an old olive-tree near Gericomio, which last year yielded 240 quarts of oil. Yet its trunk is quite hollow, and its empty shell seems to have barely

enough hold on the ground to secure it against the mountain storm."* More than 4,000,000 gallons of olive-oil were imported into Britain in the year 1831, very nearly one half of which was retained for home consumption.

Some parts of the south of Italy may be said to be one continued olive-grove. This description particularly applies to what may be called the heel of the boot, which forms an extreme point of the Neapolitan dominions. "In a good year, and at a proper season," says a writer quoted in the Library of Entertaining Knowledge, "I have counted, in the course of an afternoon's ride, as many as a hundred mules returning from Galipoli, where they had been to deposit their unctuous burdens to different towns and villages in the Terra d'Otranto, or the more distant province of Bari. The quantity of oil required may be conceived when I state, that at one time (in the year 1816) I saw nine English, three American, two French, and six Genoese vessels (not to mention some small craft from the Adriatic), all waiting in the port of Galipoli for entire or partial cargoes of it."†

It would be almost endless to state all the seeds from which useful oil may be extracted. Linseed oil, the produce of flax, is of general use in painting, and in the composition of varnishes. Its chief defect is the darkness of its colour. Hemp-seed also affords a very useful oil, similar in its qualities to linseed, but strongly impregnated with the peculiar odour of the plant. Next to these I may mention the *sesamum*, or oil-plant of the East, which is indigenous in the island of Ceylon and on the Malabar coast. It is an annual, growing about two feet high, and producing seeds of the size of those of mustard. It is grown universally throughout Asia and in some parts of Africa, where the seed is valued, not merely for its oil, but as an article of food. The oil is abundant, nine pounds of seed yielding two quarts of

* "Three Months passed in the Mountains East of Rome in 1819, by Maria Graham."

† Library of Entertaining Knowledge, Vegetable Substances, p. 201.

this substance. It is perfectly sweet, and is used for the purposes of olive oil, while it has the great advantage of not becoming rancid, though kept for years. From the kernels of walnuts, hazel-nuts, and beech-mast, and from the seeds of the poppy, oils are extracted, which are much esteemed by varnishers, on account of their transparency. The latter is also extensively used in place of olive oil. The cocoa-nut, and some species of palm, likewise yield an abundant and useful oil well known in this country; the latter being chiefly used in the manufacture of a certain kind of soap, and the former being in very general use. The chief defect of the oil extracted from the cocoa-nut, was its congealing at the ordinary temperature of the atmosphere in England. Recently, however, a discovery has been made of a method of separating the concrete matter from the liquid part of the oil, by which means a pale, limpid, tasteless fluid is produced, possessing the property of combustibility in an equal degree with the best sperm-oil, while the solid unctuous substance is applicable to the manufacture of candles, and to other uses in which fatty matter is employed. This discovery will probably be of considerable importance to the inhabitants of Ceylon, where the cocoa-nut tree is cultivated in such abundance. The utility of its oil adds to the valuable properties of this wonderful tree, which, in a former volume, were shortly described.*

FOURTH WEEK—FRIDAY.

VEGETABLE OILS ESSENTIAL AND EMPYREUMATIC.

While the grosser oils are extracted from the fruit and seed, essential oils are for the most part obtained from the leaves and flowers, or from the most odorous part of the plants. In umbelliferous plants, however,

* "Spring," p. 303. Third Edition.

the oil is found in the seeds. In the *geum* or *avens*, the root affords it; and in labiated plants, it is contained in the branches and leaves. The essential oils obtained from flowers are generally of a very delicate nature; and the odorous matter of some flowers is so subtle, that it can only be obtained by impregnating other substances with it. Of this description of flowers are the tuberose, jassmine, honeysuckle, sweet-briar, and others having strong scents, but yielding little or no oil by distillation. Ben-oil, extracted from the seeds of a tree growing in the Indies, Ceylon, and Egypt, which is perfectly inodorous, and not liable to rancidity, is an excellent agent for retaining and imparting the perfume of the sweet-smelling flowers.

Other essential oils may be obtained by distillation, water being added to the ingredients in sufficient quantity. In this manner, they are drawn from the various parts of plants which yield this substance, whether flowers, leaves, barks, roots, or woods, or from their extracts, in the form of gums or balsams.

The use of these oils to the perfumer is too well known to require explanation. Some of them are also employed in pharmacy and chemistry, others in confectionary.

But there are oils which partake of the nature of those named essential, which are of greater utility, and more extensive application. These are called empyreumatic oils, and are obtained by dry distillation.

Birch-oil is classed among these; it is prepared by the Tartars from the white bark of the birch-tree; and, what is singular, that which is extracted from bark in a rotten state, is esteemed the most valuable. It is used in the preparation of leather, for which purpose it is in great request, on account of its antiseptic qualities.

But a far more important extract, of an empyreumatic nature, is the tar, so extensively used for naval purposes. It is distilled from the wood of the fir-tree, and produced in large quantities in the north of Europe, and in North America. In the selection of the wood for this purpose,

some care is taken, as particular trees yield much more tar than others. When a sufficient quantity is collected, a circle is marked out on the ground for the kiln. The earth is then dug out, a spade deep, sloping from the centre to the circumference, and is thrown up, forming a bank round the circle. A straight pine, of sufficient length to reach from the centre some way beyond the bank, is split longitudinally, and hollowed out. The parts are then put together again, and one end is placed in the centre, being so supported on the ground, that this end is higher than that which comes without the bank, where a hole is dug in the ground, into which the tar flows from the channel, and whence it is from time to time taken out and barrelled for market, without any further preparation.

In packing the billets of wood in the kiln, the inward ends are made to slope towards the middle, which is filled up with smaller pieces, consisting of knots of wood, the most productive part of the trees. After the whole billets are piled about twelve or fourteen feet high, a number of small logs are placed round it, then a layer of turf, and so on alternately throughout the whole height. The top is then covered over with two or three layers of turf. The fire is at length let in at the top, by removing the turf in ten or twelve different places; and the pile burns slowly downwards till the whole of the tar is distilled from it. Six or eight days are generally required to complete the burning of a tar-kiln of the dimensions here described.

The above is the common method pursued in the north of Europe; but though unexpensive, it is attended with great counterbalancing inconveniences. Among these the chief are, that the management of the fire is extremely difficult, and considerable loss takes place in extracting the tar. Other methods are, therefore, resorted to by persons possessing capital, which I must not stop to detail.

The quantity of tar retained for home consumption in 1830, was 5205 lasts.

Pitch, which is condensed tar, is obtained either by evaporation or burning. The process of burning is performed very simply. A hole is dug in the ground, and lined with brick. It is then filled with tar, which is ignited, and allowed to burn till the pitch is found to be of sufficient consistency, which is ascertained by dipping a stick in it, and allowing the pitch adhering to it to cool. When the tar is sufficiently burnt, the hole is covered up, and the fire is thus extinguished.

When tar is converted into pitch in this country, a much more economical plan is pursued in the large establishments. Here no part of the tar which has any useful property is wasted. It is evaporated in a still, and consequently the valuable volatile products are condensed and preserved. The oil, the acid, and the water, which distil over, do not mix, and may be easily separated by further distillation. The oil is an inferior oil of turpentine, which is useful in coarse painting; the acid is strong and empyreumatic, very closely resembling the pyroligneous acid obtained from the distillation of wood. By this method 600 gallons, or 20 barrels of tar, will produce 10 barrels, or 2200 weight of pitch, 176 gallons of oil, and about 40 gallons of acid.

Besides the British made pitch, 5482 cwt. of foreign pitch were retained in 1830 for home consumption.

FOURTH WEEK—SATURDAY.

TREES.—TALLOW AND WAX.

There is yet another class of substances derived from some kinds of trees, which I shall describe on account of their singularity as vegetable products, and the uses which may be made of them both for domestic purposes

and in the arts; I allude to such as bear a close resemblance to tallow and wax, both of which are but little practically known in our temperate climates, except as the produce of animal secretion.*

A substance very nearly similar to tallow is procured from a tree growing abundantly in China, called the tallow-tree, or *croton sebiferum*, which is used by the inhabitants in making candles.

Mr Clark Abel describes it as being one of the largest, the most beautiful, and the most widely diffused of the plants found by him in China. "We often saw it," he says, "imitating the oak in the height of its stem, and the spread of its branches. Its foliage has the green and lustre of the laurel. Its small flowers, of a yellow colour, are borne at the end of its terminal branches. Clusters of dark-coloured seed-vessels succeed them in autumn, and when matured, burst asunder, and disclose seeds of a delicate whiteness."†

The seed-vessels are hard brownish husks, not unlike those of chesnuts; and each of them contains three round delicately white kernels, resembling in size and shape our ordinary hazel-nuts, but having small stones in the interior. It is the hard white oleaginous substance surrounding these stones which is used as tallow, and possesses most of its properties, though its consistency is so great, that in stripping it off it does not soil the fingers. From the shell and stone oil is extracted, so that the fruit produces tallow for candles, and oil for lamps.

* Bees-wax was long believed to be collected by these industrious insects from flowers; but it is now satisfactorily ascertained that they secrete it through the rings of their body. Wax, however, is not altogether unknown, even in this climate as a vegetable production. The experiments of Proust led him to believe that the bloom which silvers the surface of plums, and other stone fruits, is wax, and that the property of resisting moisture, which resides in the leaves of the cabbage, and some other plants, is owing to the presence of the same substance. Some trees, too, such as the poplar and alder, afford a decoction resembling wax or tallow. As for the latter substance, it is nearly akin to the oils which are not uncommon in the vegetable productions of temperate climates.

† Travels in China, p. 177.

The tallow thus procured is not so cohesive as that produced from the fat of animals, and to remedy this defect, the candles are dipped in wax. Father d'Incarville, in a letter published in the Philosophical Transactions in 1753, states, that almost all the candles sold in the southern provinces of China, are made with tallow prepared from these berries. There are few sheep in that part of the country, which causes animal tallow to be very scarce, and enhances the value of this vegetable production.

The piney-tree, or *Vateria Indica*, growing on the coast of Malabar, yields a substance of the same kind as that already mentioned. The peculiar product of this tree is described in an interesting paper, by Dr Benjamin Babington, published in the "Quarterly Journal of Science." He has shown, from many experiments, that its inflammable properties admirably adapt it for the manufacture of candles, and, indeed, that it is in every way superior to animal tallow. This useful substance is obtained from the pulpy fruit, by simply boiling it in water, when it rises to the surface, and, on cooling, forms a solid cake.

The natives do not make use of the substance for light, candles being unknown among them, as the country furnishes many fluid vegetable oils, with which they feed the wick of their lamps; but they employ it medicinally, considering it an excellent application for bruises or rheumatic pains.

A resin, very similar in its properties to that of copal, exudes from the piney tree, and furnishes a very durable natural varnish. This resin, when mixed up with the tallow of the tree, is used as a substitute for tar, in smearing the bottoms of boats.

The produce of the piney tree might form a useful and profitable article of commerce. It grows abundantly along the western coast of the Peninsula of India, as far northward as the extreme limit of the province of Canara.

Wax is produced from a species of palm, which grows in the Brazils, and rises to the height of thirty feet, called by the inhabitants Carnauba. The lowlands on the banks of some of the rivers are covered with these trees. The leaves are two feet in length, and, while young, are folded in the manner of a fan: when they afterwards expand, they are nearly two feet in breadth. When cut from the tree, as soon as they have reached their full growth, and placed to dry in the shade, a considerable quantity of small light-coloured scales will be loosened from the surface. These acquire the appearance of wax, when fused, which takes place on the application of heat at 206° Fahrenheit. This wax is of a pale straw colour, and, when cold, is hard and brittle. Fixed oils, at the temperature of boiling water, cause its solution. It possesses most of the properties of bees' wax, and, when made into candles, burns well with a steady light.

In the Philosophical Transactions for 1811, there is a detailed account of the experiments made on this wax, to ascertain its properties as an inflammable substance. These experiments proved highly satisfactory. It was found, that, when made into candles, with wicks of proper thickness, its combustion was in no respect inferior to that of bees' wax.

Nor is this the only useful product of the carnauba-tree. The green fruit, and the pith of the young stem, when properly prepared, afford a nutritive food; the kernel of the fruit, when ripe, is covered with a layer of sweet pulp, which is found to be a wholesome nourishment for cattle; the beans make a very durable thatch for houses; and the trunk is serviceable as timber.

Another species of the highly useful and much diversified palm tribe, the *Ceroxylon*, produces also a substance possessing the properties of wax. It is a native of the Andes, and grows in high situations bordering on the region of perpetual snow. Humboldt describes the tree as attaining to the prodigious height of 160 feet, while it differs from all other species of palms, in flourishing

under a much colder temperature. It is on the trunk of this tree that the inflammable substance is found, of which I speak. Vauquélin subjected this product to chemical analysis, and found that it contained two-thirds of resin, and one-third of wax.

There are, in the northern quarter of the New World, shrubs which produce wax of a much purer quality. Of this kind is the myrtle of Louisiana, scientifically called *Cerefera augustifolia*, and another species, with broad leaves, which grows in Pennsylvania, Connecticut, and Virginia. These yield their wax from the berries, this substance surrounding a small stone in the centre of the fruit. When made into candles, this wax produces a clear white flame, affording a grateful light, while it emits an agreeable and healthful fragrance.

It has already been remarked, that there are in various departments of nature, principles and qualities which seem to be lying waste, or which are, at all events, but partially employed, and which it only requires the judicious labour of man to call forth in abundance. In noticing this fact, I took occasion to state, that these resources lead us to look forward to a period in which the improvements introduced by genius and industry, will people the earth to a far greater extent than has yet been realized. A similar view may be taken of the vegetable powers which we have just been considering. The productions in question exist in a much greater profusion, than the wants of man in his present condition require; but the time may come when all their qualities shall be called into action, and shall contribute to the prosperity and comfort of a vastly increased population. The croton and piney trees may yet be eagerly sought after and extensively cultivated, for the sake of their tallow, and other properties; and the wax-palm of the lofty Andes, carefully reared in its own locality, or transplanted to our northern climes, may yet furnish its peculiar produce, to add to the resources of the arts, at a period when the dense population of an enlightened

and industrious community, shall have found that the present means by which its use is superseded, have become too scanty for the supply of their incalculably augmented demands. The philosopher, as well as the man of piety, must therefore come to the conclusion, that, to allege that any natural production, capable of being turned to use, is superfluous or superabundant, merely because it remains at present unemployed, is quite premature and unwarrantable. He will even go further, and will see in the provision, a prospective contrivance of Creative Wisdom anticipating coming necessities, which opens to his mind the most magnificent prospects.

FIFTH WEEK—SUNDAY.

SPIRITUAL CULTURE.

The apostle Paul says of Christians, that they are "God's husbandry," which implies that they are under a process of cultivation. The metaphor is very striking and appropriate. The face of an uncultivated country is generally a wilderness, covered with weeds, brambles, and thorns, or encumbered with useless trees. Such is the curse of a fallen world. Before it can be rendered an agreeable and productive residence for human beings, the soil must be cleared of its natural produce; it must be divided into fields, and fenced in from encroachment; it must be turned over and pulverized; it must be ameliorated by manure, and good seed must be sown; or it must be adorned with useful plants and trees.

So it is with the human heart. The curse of the fall is on our souls, as well as on the ground. The natural produce of this living soil is weeds, and thorns, and noxious plants. These grow luxuriantly, and choke the good seed that may chance to be scattered on this preoccupied wilderness. There is a difference, indeed, as has been said, in the natural quality of the soil. In one place there is the hardness of rock; in another there is the stiffness of clay; in another there is a native fertility. But while, in barren regions, nothing is produced but a sour and stunted vegetation, even the very richness of the soil causes poisonous herbs, and useless or baneful plants, to grow the ranker.

Such is the natural state of the human soil, and before it can become productive of good fruit, it must, like the soil of the earth, be subjected to the ameliorating influences of cultivation. To keep up the metaphor, it must be cleared of its unprofitable and poisonous produce; it must be skilfully dressed and prepared; it

must be sown with useful seed; it must be watched over, and preserved from depredation.

But let us drop this figurative language for a little, and take a literal view of the human character. Such is the nature of our fallen hearts, that evil is more congenial to them than good. The moral principle within us is depraved, so that we are constantly inclined to harbour bad passions, and cherish worldly inclinations. In our infancy, we are selfish and trifling; as we grow up we become vain, malicious, and grasping; evil habits are formed, and intwine themselves round the heart. Our fellows are of like passions and affections with ourselves. By mutual intercourse we corrupt each other, and so the work of demoralization proceeds. This is a hopeless state, if human means alone are employed. Men make progress in the arts and sciences, but they do not of themselves make salutary progress in moral culture. On the contrary, if we examine history, we shall find that society has almost uniformly made a retrograde movement in virtue and religion, as they advanced in civilization. Look at the antediluvian world. It was the improvement of men in the arts of civilized life, and their consequent familiar intercourse with the most depraved, but the most ingenious of their species, which caused that universal dissolution of moral and religious principle, that, in the days of Noah, was so signally visited with the vengeance of Heaven. Look at Egypt, at Babylon, at classic Greece and Rome, and the very same effect will be observed. Consider the history even of the Israelites. They were not able, with all their peculiar advantages, to resist the corrupting influences of prosperity. Shall we draw a different conclusion from the history of modern Europe? It will not be said.—Its inhabitants, indeed, have possessed that which, if properly applied, would have preserved them from the contamination; but religion itself was corrupted, and thus the genial stream, which might have produced salubrity, was vitiated at its source.

The soil of the human heart, then, considered with reference to religion, is naturally a wilderness, which grows only the more encumbered with a noxious vegetation, the more its fertility is increased. It may, however, be cultivated; but this, as formerly observed, can only be done by a Divine hand. As well might you expect that the earth should change its nature and its produce without the culture of man, as that the moral soil should produce good fruit without the "husbandry" of Heaven. Human means, indeed, must be employed. Such is the wise arrangement of the Supreme Governor; but without Divine aid, these means are altogether unavailing. Neither your own efforts, nor those of your spiritual husbandmen, can cause the sacred seed to take root and grow in your hearts. If the influences of Heaven be denied, these are all in vain. "Paul may plant, and Apollos may water, but it is God who giveth the increase."

This is the important truth. The whole operation is of God. God's field is the world; the ministers who cultivate it are God's servants; the seed which they sow is God's word; it is the "Sun of Righteousness" which sheds over it light and heat; it is the rain of heaven which waters and nourishes it; it is the power of the Creator which has endowed the seed with those mysterious qualities, in virtue of which it yields to such influences, extending its roots, and shooting forth its stem, till its fruit bursts forth and ripens.

There is, however, an essential difference between the soil of the human heart and that which the literal husbandman dresses. The ground is altogether passive to the hand of the cultivator. When operated upon, it exerts no *will* either in withholding or giving out its powers. It is not so with man. He is a living soul. God gives him freedom of choice, and deals with him as a rational creature. He offers him the culture which may fit him for the garners of heaven, but he may reject it. It is this which renders him an account-

able moral agent, and a proper subject of reward or punishment.

This remark applies not only to the first reception, but to the future growth of the Divine seed. We must be willing not only that the seed should take root, but that it should shoot forth and bear fruit. The seed may be sown, but it may lie unproductive in a cold and ungenial, because an unwilling, soil. We must give out our natural powers to cherish it. It is not enough that it is there. If we are satisfied with this, there is but too good reason to believe that the soil is bad. Its nature will be seen by the tendency of the seed to grow.

The sacred writers constantly refer to this progressive nature of Christian principle, and they express it by reference to all kinds of growth,—to the growth of the lower animals, as when it is said of believers, that "they shall grow up like calves in the stall," thriving under the hand of their feeder, and rapidly increasing in size and in strength,—to human growth, as when we read of babes who cannot digest strong food, but must be fed with "the milk of the word;" of children rising to the full stature of manhood; and of the aged head, surrounded with grey hairs as a crown of glory. Nor do we read less frequently of vegetable growth as an emblem of the progress of spiritual life,—it is compared to wheat, which produces first the blade, then the ear, then the full corn in the ear; it is said to spring up like grass, and like willows by the water courses; to flower as the lily; to produce fruit as the fig-tree and the vine.

Sometimes we see the vigour, the beauty, and the fertility thus indicated, most cheeringly exemplified in real life. There are not unfrequent instances in which the rapidity and luxuriance of spiritual growth fill all who witness it with admiration. The young convert passes so quickly through the various stages of the blade, the ear, and the full corn—of childhood, youth, and manhood—that they can scarcely be distinguished. He acquires, as if by intuition, mature and exalted views of

the things of God; his heart becomes all at once, as it were, established in grace, and depends simply and entirely on the merits of his Redeemer; he is separated from the world, yet eager to do good, and to communicate instruction to those who still continue its slaves; he has already arrived at the full strength and wisdom of manhood, and adorns the doctrine of his Lord and Saviour.

But this is not the usual course. Alas! in how many instances do we observe a slowness of spiritual expansion, which marks how little energy there is in the will we exert to call forth the powers of the soil. Notwithstanding all the advantages bestowed by the Heavenly Husbandman,—the means he employs to clear the field of its noxious produce, to manure it, to dress it, and to sow good seed,—how feeble the vegetation! Spring passes away, and summer arrives, yet the progress is scarcely perceptible. The sun shines, and the rain descends, but the soil is cold and barren. It seems as if the seasons would run their round, and winter, when it arrives, would find the plant as it was left in spring, without fruit, and of stinted growth.

But still there is encouragement. If the seed has really taken firm root, it will grow. We are "God's husbandry." It is He who "gives the increase." The sky may frown, and tempests may blow, but He who said to the winds, "Peace, be still," will not forsake his own. If we have energies which we must exert, we have also strength to help us. He who has commanded us to grow in grace, has also promised that his grace shall be sufficient for us. We know to whom we may freely apply for aid. Christ came, not merely that we might have life, but that we "might have it more abundantly." If we are, indeed, under the culture of the Divine Husbandman, he will perfect the good work which he has begun in us. Let us, then, take courage, and open our blossoms to the genial influences which he sheds around us.

FIFTH WEEK—MONDAY.

VEGETABLE LIFE IN THE POLAR REGIONS.

Before leaving the subject of vegetation, it would be improper to omit some account of the state of that department of nature in the polar regions, which, in so many particulars, is remarkably contrasted with the same department under the other extreme of the tropics, and this matter has been so appropriately treated in the "Edinburgh Cabinet Library,"* that I shall have little more to do than to curtail that interesting account.

The vegetable world does not, in this dark and outer boundary of the earth, possess such an important and commanding character as the animal, which will afterwards be noticed. The Creator, without departing wholly from the system and laws he has prescribed to nature, could not clothe with vegetable verdure a soil which, for nine months in the year, is frozen as hard as a rock, and covered with snow many feet deep. The seeds of more genial climates, indeed, when sown during the short and bright summer, spring up, and wear for some time a promising appearance, but they are all nipt by the untimely winter. Still nature, in the northern regions, approaching the Arctic Zone, does employ resources suited to the peculiar circumstances of the climate.

The fir, the pine, and other trees of these regions, on being pierced, distil, not the balmy and fragrant gums of Arabia and India, but rich, thick, coarse juices, by which their interior heat has been preserved, and which, when prepared as pitch, tar, and turpentine, serve many valuable purposes of commerce. Through the cherishing influences of these juices, the lakes of North America are bordered with tall dark forests, which afford to more favoured countries, an inexhaustible supply of valuable timber. Even their gloomy foliage, while the forests of the south are every autumn strewing the ground

* Polar Seas and Regions, pp. 79-96.

with their faded leaves, brave through the winter all the fury of the northern tempest. But, before reaching the inclement sky of the Arctic Circle, this magnificent growth decays. Trees, which in a more southerly region, are the pride of the forest, dwindle into meagre and stunted shrubs. Beyond this circle, these monarchs of the wood, if they appear, rise only to the height of a few feet, throwing out lateral branches. On Melville Peninsula, dwarf willow, and the *Andromeda tetragona*, almost alone afford to the Esquimaux a scanty supply of wood for their arms and utensils. Considerable quantities of drift timber are, however, frequently found along the barren shores of the Arctic Regions, supposed to have floated from the mouths of the Siberian and other northern rivers.

The plants which abound most in these dreary climates, belong to the tribes of mosses and lichens, the *cryptogamia* of Linnæus, the *acotyledones* of Jussieu. The meagre vegetation with which the arctic surface is covered, thus appears rather as if it were the produce of the rocks than of the soil. Yet the moss and lichen, which form the prevailing features, are not only copiously produced, but possess a nutritious and salutary quality, not displayed in more fortunate regions. One species of lichen (*L. rangiferinus*), forms, as it were, the main staff of life to the Laplander. It supports the rein-deer, and the rein-deer supports him. The lichen of Iceland, boiled in soup, or even converted into bread, is to the natives a substantial part of their subsistence. Farther north, where the depth of the snow, and the continuance of frost, drive the inhabitants to the shore and to animal food, these vegetables still afford support to the deer, and to the other quadrupeds, which they use as aliment. It is even with a species of moss that they trim their lamps. The fungus, or mushroom, which draws nourishment without the aid of a proper root, and the *filices*, or ferns, which consist only of one spreading leaf, the middle rib of which forms all their stalk, while

their slender roots spread under the ground,—these find the means of existence even in Greenland.

The *fucus* tribes, comprehending nearly all the variety of marine botany, grow in vast abundance on the northern shores. These rude plants, which have little or no distinction of stem, root, or leaves, and whose fructification is often included within the substance of the frond, cover the Greenland coast with submarine meadows. The *confervæ*, too, with their numerous filaments, spring up in profusion.

A few plants, not belonging to this imperfect order of vegetation, embellish, during the short summer gleam, the northern fields. Under the bright influence of the sun at this season, indeed, some of the most beautiful among the floral tribe expand their petals. The ranunculus and anemone display their rich and varied tints; several species of saxifrage flourish; and the yellow poppy has even a gaudy appearance, so that the poppy genus, which enriches the plains of Hindostan, is among the last to expire under the snows of the pole.

The nobler fruits do not ripen under this ungenial sky; yet shrubs, producing delicious berries, appear on the borders, at least, of the arctic zone, in great profusion. The northern Indians consider the fruit of a bush, called *aronia ovalis*, as the most agreeable food; besides which, they have the strawberry, the raspberry, the red whortleberry, and various others. Some of these are covered beneath the first snows of winter, which are supposed to mellow them, and which, when dissolved by spring, show the berries still hanging on the branches, thus furnishing an early supply of grateful food, while the buds of all the others are bursting,—the whole producing a delightful impression, unknown to those who have not witnessed the desolation which immediately preceded.

These bleak regions enjoy a precious boon in the plants which act as an antidote to scurvy, and which defy the most severe cold of the arctic zone. The

cochléaria, a thick-tufted juicy plant, of extreme fecundity, is emphatically called *scurvy-grass;* and different species of sorrel were found by Captain Parry flourishing under the snow, at the very farthest limit of vegetation.

Among the other phenomena of the arctic regions, may be mentioned that singular production which astonished the northern voyagers by the appearance of red snow. The following is the account of this appearance contained in the work which I am at present following: —"This singular aspect of a substance, with which we never fail to associate an idea of the purest and most radiant whiteness, has been ascertained to result from an assemblage of very minute vegetable bodies, belonging to the class of cryptogamic plants, and the natural order, called *algæ*. They form the species named *protococcus nivalis*, by Agardh, which is synonymous with the *uredo nivalis* of Mr Bauer. This plant seems by no means peculiar to the arctic snows, but occurs on limestone rocks on the island of Lismore, in Scotland, as well as among the Alpine and other countries of Europe."—"According to Captain Ross, the arctic mountains on which he observed the red snow, are about 600 feet high, and extend eight miles in length. The depth to which the colour penetrated has been variously stated by different observers. Some found that it descended many feet beneath the surface, while others never ascertained that it spread beyond one or two inches. There is no reason to suppose that the colouring matter itself, as well as the snow, is a meteorological product, although Humboldt certainly mentions a shower of red hail, which fell at Paramo de Guanacos, in South America. Moisture is, no doubt, essential to the production of this plant, as it is to all the other algæ; but when once formed, it seems to possess the power of continued and increasing vegetation, even over rocks and stones, with only an occasional supply of fluid."*

* Edinburgh Cabinet Library—Polar Seas and Regions, pp. 83, 84.

A very different account has lately been given of the origin of red snow, which, if corroborated, will prove that the colouring matter is not a vegetable substance at all, but the excrement of a bird. Mr Nicholson, who made an expedition to Regent's Bay in 1821, states, that he there observed crimson snow, and that it was evident, at first view, that the colouring matter lay on the surface. "This substance," says he, "lay scattered here and there in small masses, bearing some resemblance to powdered cochineal, surrounded by a lighter shade, which was produced by the colouring matter being partly dissolved and diffused by the deliquescent snow. During this examination, our hats and upper garments were observed to be daubed with a substance of a similar red colour, and a moment's reflection convinced us that this was the excrement of the little auk, myriads of which were continually flying over our heads, having their nests among the loose masses of granite. A ready explanation of the origin of red snow was now presented to us, and not a doubt remained in the mind of any that this was the correct one."*

It will be at once amusing and instructive, should this view be confirmed, to discover that a substance which has been soberly treated of by naturalists as a plant, the order of which has been settled, the name of which has been added to the calendar, and on which theories have been formed, should after all prove to be nothing more than animal excrement. The showers of blood which have sometimes alarmed nations by their fall, have, in like manner, been proved to be the red ejection of a species of butterfly.

It appears that the same substance which gives the red colour to snow, is occasionally detected, even during the warmth of summer, covering the brilliant white limestone of the plains. In the last named locality, it was discovered by the Baron Wrangler, in the province of Nerike. It was believed by him to be of a different

* Magazine of Natural History, vol. ii. p. 322.

species. If, after all, it be the excrement of a bird, which I am inclined to believe, it will not be surprising that it should be found in such different localities and seasons.

In reviewing this account of northern vegetation, it is interesting to remark the adaptations by which the general laws impressed on this department of nature are rendered consistent with the propagation and preservation of useful plants, under circumstances of climate which would render the raising of any of the ordinary kinds of the produce of the soil utterly hopeless. Among these provisions the reader would not fail to remark, the thickened juices of the pine tribe, and their retention of their bristly foliage during the severity of winter, as means obviously intended to fit them for an ungenial climate; the abundance of mosses and lichens, endowed with qualities which render them nourishing food for man, or for the animals which contribute to his subsistence and comfort; the profusion of edible berries, and of salubrious grasses; and even the existence of beautiful flowers, which adorn the short-lived arctic summer. How edifying is it to find, that even in the most inhospitable climes, there are traces of a Father's care in the gifts which his bounty scatters.

FIFTH WEEK—TUESDAY.

CONNEXION BETWEEN THE VEGETABLE AND ANIMAL KINGDOMS.

In examining the character and properties of the vegetable creation, we have only been contemplating the various provisions which the Self-Existent has made for the subsistence of the animal creation. Without the existence of animated beings, vegetation, in all its remarkable varieties, would have been but an unmeaning pageant,—contrivance without an object,—mechanism without use,—a system of inventions and adaptations,

amazing for their extent, their variety, and the depth of thought which they displayed, without any adequate end. It would be as if a magnificent and admirably furnished edifice were erected in a wilderness where there was no being to inhabit it. To communicate happiness, to inspire intelligence, and to call forth the exalted feelings of admiration and gratitude, or, in other words, to form sentient and rational beings, seem to be the only conceivable ends of creation. In the lower orders of animals, we observe the first obscure rudiments of such a design. These intentions we see still further developed in the faculties bestowed on man, and the circumstances in which he is placed in this sublunary state; but we must look beyond the present scene, and, aided by the light of revelation, take a glance into futurity, before we perceive the full scheme unfolded, or understand in what sense it is, that the great end of creation is to enable intelligent beings to glorify and enjoy their Creator.

Considered in this view, the first thing that attracts our attention is, that the organs of living creatures, and the peculiar chemical condition of their structure, are such as rendered the vegetable world necessary for their subsistence. The combination of their elements is so refined and complicated, as to require a succession of changes to fit the inorganic world for the necessary assimulation. In their crude state, the soil and the rocks, of which the earth is composed, are not capable of sustaining animal existence. The animal organs cannot appropriate them, nor the animal powers digest them. It was necessary that these unorganized materials should undergo a process of selection and secretion before they could be suited to the support of the animal frame, and this office is assigned to the vegetable kingdom. It would be rash to say, that the Creator could not have so arranged the inorganic and animal worlds, as to make the one supply the wants of the other, without the intervention of intermediate changes; but in the arrangement actually adopted, there is an obvious and beautiful pro-

priety, which marks it as the work of Supreme Intelligence. Vegetable existences extract, from the earth and atmosphere, the simple food furnished by nature, which consists chiefly of water, air, and carbonic acid; they elaborate these elements in their secretive organs, and causing them to undergo various modifications, convert them into aliments, which not only maintain their own vitality, but prepare them as the means of subsistence to the higher world of animals. These animals, again, are endowed with organs and functions capable of receiving such aliments, and converting them to their own use, so as to complete a system, wonderful at once for its simplicity and complexness. Such is the nature of the connexion between the two worlds of organized existences.

But, further, animal life might have been preserved in all its varieties by a single order of plants, had this been the whole intention. But how diversified are the forms and properties which have actually been produced! This was not without design. With regard to man, I have already pointed out very many advantages, embracing bodily vigour, mental improvement, and varied enjoyment, which result from such diversity. Others will appear at every step of our progress in contemplating the works of the Creator. With regard to the inferior animals, it is not so easy to speak with precision; but when it is remembered, that for all the varieties of the vegetable world, there are corresponding varieties among animals, we cannot withhold our conviction, that there are here contrivances and adaptations; and, on considering the character of the Creator as reflected from the works whose objects we are enabled to trace, we feel warranted to add, that these contrivances and adaptations are wise and benevolent.

It is to the animal world, then, that we must direct our view, if we would rightly estimate the mighty plan of creation. Vegetation, considered in its primary intention, is nothing more than a subservient contrivance,

by which the animal frame shall be mechanically sustained, its organization developed, and its waste repaired. If with this be united varied enjoyment, arising from the exercise of the functions and senses, it is because a paternal God was pleased, in the exuberance of his bounty, to cause these subordinate arrangements to be directly conducive to the *ends* of animal existence, as well as to its means. But so far as the human race is concerned, even the pleasures which they derive from their connexion with the vegetable world are but subordinate to a much higher object, and can only be regarded as faint and scattered emanations from the Great Source of light and happiness, the foretaste of enjoyments unalloyed and endless.

Considered, then, as an end, the vegetable world was called into existence, and endowed with all its properties, exclusively with reference to the animal world; although the various relations and fitnesses, which subsist among the diversified orders of the former with regard to each other, may well form a subject of separate investigation. Vegetation exists for the use of living beings. Whatever properties it possesses are their inheritance, made and maintained expressly for them. Whether a plant be succulent or dry, hard or soft,—whether it be a grass, a flower, a shrub, or a tree,—whatever juices it selects from the earth,—whatever chemical changes these juices undergo in the leaves or other secretory organs,—whatever be the form it assumes, the colours it reflects, or the odour it exhales, it is not for itself or its fellows that it thus exists, but for another world, the world of sentient beings.

This considered in itself, is a very remarkable arrangement, clearly indicating design; and when the particulars are examined, not only is this general view confirmed, but our admiration is greatly increased. Here are two distinct orders of existences in their general characters altogether different, yet so intimately connected, and so beautifully fitted to each other, that without the

one the other could not exist at all, or would exist for no end. What gave rise to this remarkable adjustment, this necessary connexion? The answer is obvious,—A Contriving Mind, that could form comprehensive schemes, that could combine mighty powers naturally distinct, that could foresee and provide for conditions and relations vast, profound, and complicated.

FIFTH WEEK—WEDNESDAY.

THE SENSORIAL ORGANS.

In the volume on Spring, I took notice of the general principles which enter into the animal structure, such as the nature of the tendons, membranes, and ligaments, the functions of digestion, secretion, and muscular power, the circulation of the blood, &c. There are, however, some other important provisions in the animal frame, which have either not been mentioned at all, or have only been mentioned incidentally, and which now seem to invite particular notice, as introductory to a consideration of animal existences, in their state of full development. I allude chiefly to the different organs of sense, which shall form the subject of this paper.

Living creatures, being intended to perform voluntary actions, required some means of communication with the external world. This it has pleased Providence to afford them, by five different avenues. How many others might have been bestowed, in order to give them a complete acquaintance with natural things, it is impossible even to conjecture; yet while, on the one hand, we cannot but be aware that there are many existences, and many qualities of bodies, which lie beyond the ken of our senses, and which we can, therefore, no more perceive than a man born blind can perceive an object of vision, we ought gratefully to acknowledge that the powers of

sensation and perception actually allotted to us, are quite sufficient for all the purposes of sublunary life.

To be made sensible of the presence of bodies with which we are in immediate contact, seems to be the most simple mode of communication with the external world; which is effected by the sense of touch: But what a complicated and curious system does even this require. The seat of perception is in the brain; and, that the knowledge in question may be obtained, it was necessary that there should be messengers and channels of communication to it from every part of the body. This is accomplished by peculiar, and, in some respects, recondite contrivances, in what is called the nervous system. The sense of touch is chiefly confined to the outer surface of living bodies, because it is here that they come in contact with the external world. To understand the material mechanism through which it is perceived, it must be observed, that the skin consists of three parts, of which the *corium* forms the principal portion, and the cuticle the outermost layer, between which there occurs a thin layer of a substance called the *rete mucosum*. The corium is constructed of an intermixture of dense and tough fibres, through which a multitude of blood-vessels and nerves are interspersed; but its exterior surface is more vascular than any other part, exhibiting a fine and delicate network of vessels, named by anatomists the *vascular plexus*. It is here that the sensation of touch is principally situated; and we may infer that it contains the terminations of all the nervous filaments appropriated to this organ, which are here found to be divided to an extreme degree of minuteness. When examined with the microscope, this surface presents a great number of minute projections which have received the name of *papillæ*, and which seem essential to the perfection of the sensation, as they are particularly conspicuous on those parts of the skin which are most essentially appropriated to this sense, such as the tongue, the lips, and, in man, also the tips of the fingers. To protect this structure of ex-

quisite sensibility, the cuticle is provided, an external covering entirely insensible, which envelopes the whole.

Such is a condensed account of the appearance and distribution of the nerves of touch; and I have only further to add, that this system may be traced till all its minute ramifications are concentrated and terminated in the brain. Beyond this all is mystery.

The senses of taste and smell are intended to convey impressions resulting from the chemical qualities of bodies, the one in the liquid or solid, the other in the gaseous state; and there appears to be a considerable analogy between those two senses; indeed, they may be said to be only peculiar modifications of the sensation of touch. The organ of taste is the surface of the tongue, the skin of which is furnished with a large proportion of blood vessels and nerves, and here the vascular *plexus* is particularly conspicuous. It is intended, as its primary use, to guide animals in the choice of their food, and to warn them against the introduction of any noxious substance into the stomach, and is therefore placed in the mouth, through which aliment is received.

The sense of smell, on the other hand, is chiefly intended to protect the animal from the reception of noxious effluvia into the lungs, and hence it is usually made to occupy the beginning of the passages of respiration. It also materially assists the sense of taste, giving rise to what is called flavour; and, on this account, is placed in the immediate neighbourhood of the latter organ. The cavity of the nostrils is lined by a soft membrane, constantly kept moist, which is supplied with numerous blood vessels, and upon which are spread the ultimate ramifications of the olfactory nerves. In quadrupeds, as well as in man, these nerves are not collected into a single trunk, in their course towards the brain, but compose a great number of filaments, which pass separately into the cavity of the skull, through minute perforations in a plate of bone.

As there is an analogy between the three senses al-

ready mentioned, so there is this analogy between the other two, that it is by hearing and sight that animals chiefly acquire the knowledge of the existence and movements of distant objects; sound results from certain tremulous or vibratory motions of the particles of an elastic medium, such as air or water, excited by some sudden impulse or concussion. These sonorous vibrations, being transmitted with great velocity, strike on the external ear, and then, after being concentrated in the internal passages of the organ, they are made to act on the filaments of a particular nerve, called the *acoustic* or *auditory* nerve, the structure of which is adapted to receive these particular impressions, and convey them to the brain.

Sight is the most refined and admirable of all the senses. It is intended to convey to animals a knowledge of the existence, situation, and colour of distant objects, which it does by means of the light reflected in all directions from these objects. The sensation is produced through the medium of the *retina* of the eye, as I have already had occasion to remark, on which the rays of light are thrown, in a concentrated form, and from which an immediate communication is established with the brain.

Such is, in few words, the material apparatus, through the medium of which the knowledge of external objects is conveyed to that principle in animals, whatever it may be, which possesses the faculty of sensation and perception. Even this necessarily slight and imperfect sketch is sufficient to impress the mind with a conviction that this diversified mechanism, and its results, could only originate in benevolent intention and profound contrivance. A more minute inquiry not only confirms this conviction, but, in proportion to the skill with which it is conducted, increases our admiration of the Divine Contriver, till we are lost in astonishment; and, as we stretch our mental powers to comprehend the subject, we become sensible of their utter inadequacy.

I have, in a previous paper, adverted to the mechanical structure of the eye as an optical instrument; but there are very many circumstances of adjustment and construction, both in the instrument itself, and in the parts connected with it, no less obviously the result of design and consummate skill, to which I have not adverted. Take for example the crystalline lens. This central part in the eye of a codfish has been accurately analyzed by Sir David Brewster; and, by the help of a powerful microscope, he has discovered that, minute as it is, and perfectly transparent, it is composed of upwards of five millions of fibres, which lock into one another by means of more than sixty-two thousand five hundred millions of teeth! This is only a single instance of those mechanical wonders which are to be found in the examination of every part of the animal frame, and especially of the sensorial organs. How infinitely, then, does the workmanship, in its details, as well as in its united effects, surpass all our powers of conception!

FIFTH WEEK—THURSDAY.

SENSATION AND PERCEPTION.

Having adverted to the organic structure by which the existence and qualities of external objects are perceived, some general observations seem to be called for, on the nature of that structure, and of the faculties connected with it. This agreeable task I shall perform, by making a free use of the observations of Dr Roget,* to whom I have been so often indebted for information on all subjects connected with physiology.

To a person unused to reflection, the phenomena of sensation and perception may appear to require no elaborate investigation. That he may behold external ob-

* Bridgewater Treatise, Chapter on the Sensorial Functions, vol. ii.

jects, nothing more seems necessary than to direct his eyes towards them. He feels as if the sight of these objects were a necessary consequence of the motion of his eyeballs, and he never suspects that there can be any thing marvellous in the function of the eye, or that any other organ is concerned in the simple act of vision. If he wishes to ascertain the solidity of an object within his reach, he knows that he has but to stretch forth his hand, and to feel in what degree it resists the pressure he gives it. No exertion even of this kind is required for hearing the voices of his companions, or for being apprized of the pealing of the distant thunder. Yet how much is really implied in all these apparently simple phenomena. Science, we see, has taught us, that these perceptions, far from being direct or intuitive, are only the final results of a long series of operations, produced by agents of a most subtle nature, which act by curious and complicated laws, upon a refined organization, disposed in particular situations in our bodies, and adjusted with admirable art to receive their impressions, to modify and combine them in a certain order, and to convey them in regular succession, and without confusion, to the immediate seat of sensation.

Yet this process, complicated as it may appear, constitutes but the first stage of the entire function of *perception;* for, before the mind can arrive at a distinct knowledge of the presence and peculiar qualities of the external object which gives rise to the sensation, a long series of mental changes must intervene, and many intellectual operations must be performed. All these take place in such rapid succession, that, even when we include the movement of the limb, which is consequent on the perception, and which we naturally consider as part of the same action, the whole appears to occupy but a single instant. Upon a careful analysis of the phenomenon, however, it has been found that no less than twelve distinguishable kinds of changes must always intervene, in regular succession, between the action of the

external object on the organ of sense, and the voluntary movement of the limb which it excites.

The external agents capable of affecting the different parts of the nervous system, so as to produce sensation, are of different kinds, and are governed by laws peculiar to themselves. The structure of the organ is accordingly adapted, in each particular case, to receive the impressions made by such agents, and is modified in exact conformity to the laws they obey. Thus the retina is adapted to the action of light, and the various parts of the eye through which the rays pass, before reaching the retina, are constructed with strict regard to the laws of optics. In like manner, the ear is so formed as to receive delicate impressions from those vibrations of the air which occasion sound. The function of each nerve of sense is determinate, and can be executed by no other part of the nervous system. The functions are not interchangable, as is the case with many others in animal life. No nerve but the optic nerve, and no part of that nerve except the retina, is capable, however impressed, of giving rise to the sensation of sight; no part of the nervous system, but the auditory nerve, can convey that of sound. The very same thing may be said, *mutatis mutandis*, of the three other senses. There is a peculiar set of nerves for tasting, another for smell, and another still for touch.

What is further worthy of remark is, that, in almost every case, the impression made on the sentient extremity of the appropriate nerve, is not the direct effect of the external body, but results from the agency of some intervening medium. There is always a portion of organic matter interposed between the object and the nerve on which the impression is made, so that these never come into direct contact. This is true even in the case of touch, where the organ is defended by the insensible cuticle, through which the impression is made, and by means of which it is duly modified. In the organs of taste and smell, too, the same observation applies, the nerves of these organs being not only defended by cuticle,

but secured from too violent action, by a secretion expressly provided for that purpose. In the senses of hearing and vision, the changes which take place in the organs interposed between the external impressions and the nerves, are still more remarkable and important. The objects of these senses, as well as those of smell, being situated at a distance, produce their first impressions, by the aid of some medium, exterior to our bodies, through which their influence extends. Thus the air is the usual medium through which light, sound, and odour are conveyed to their respective organs. The physical laws which regulate this medium, as well as those which belong to the agents themselves, must therefore be taken into account, before we can fully understand the phenomena of sensation.

We have thus before us a most complicated system of contrivances and adaptations, which meet us on every side, and are full of instruction. Whether we consider the peculiar laws of the external world, by which they are fitted for the conveyance of the various sensations, —the laws of solid and liquid bodies, of sound, of light, of odoriferous effluvia, of the atmosphere;—or regard, in the organization of living bodies, the nerves of feeling, of taste, of smell, of hearing, and of sight, with the beautifully constructed mechanism, by means of which these nerves are enabled to perform their functions; or examine the nice adjustments by which such various and naturally distinct and unconnected objects are made to harmonize, coalesce, and co-operate, in producing the desired results; or, finally, attend to the nature of these results, as relates to the existence and happiness of sentient beings, we are at a loss what to admire most, and are irresistibly led to acknowledge and adore, in them all, the work of a Being transcendent in every conceivable perfection.

FIFTH WEEK—FRIDAY.

THE ARGONAUT AND NAUTILUS.*

HAVING, in the "Winter" Volume, considered animals in their dormant state, and, in that of "Spring," described their reproductive powers and instincts, it is my intention now to give some account of their faculties, qualities, and actions in their full development, proceeding according to the plan I have uniformly adopted, and selecting such remarkable cases, in the various genera, as may serve best to illustrate the perfections and modes of operation of the Creator.

"The bed of the mighty ocean," says Kirby, "is not only planted with a variety of herbs, which afford pasture to many of its animal inhabitants; but it has other productions, which represent a forest of trees and shrubs, and are, strictly speaking, the first members of the zoological world, connecting it with the vegetable. These are denominated *Zoophytes*, or animal plants, and *Polypes*. This last name has been adopted from Aristotle; with him, however, and the ancients, it is evidently used to designate the Argonaut and Nautilus of the moderns, and also to include some terrestrial shells. The zoophytes are not confined to the ocean; every rivulet, and stagnant ditch, or pool, affords to some kinds, most commonly denominated Polypes, and also to some sponges, their destined habitation. An infinite army of shell-fish, whether multivalve, bivalve, or univalve, also cover the bed of the ocean, or move in its waters; and some

* It may be proper, once for all, to acknowledge that I am chiefly indebted for the facts in natural history, of which I have made use in the following papers, to Goldsmith's Animated Nature, the Bridgewater Treatises of Mr Kirby on habits and instincts, and Dr Roget on physiology, and to the works on Insects, Birds, &c., published in the Library of Useful Knowledge, as well as to the posthumous work of Dr Macculloch, on the Attributes of God, published while this volume was preparing for the press.

dance gaily on its surface with extended sails or dashing oars, when tempted by fair weather."

Contenting myself with this general account of the inferior inhabitants of the ocean, I shall select only two species of this class for particular description, the first of which shall be taken from the tribe last alluded to,—I mean that of those which "dance gaily on the surface of the ocean, with expanded sails and dashing oars."

There are several kinds of shell animals, which use the apparatus nature has bestowed on them, to navigate the surface of the ocean. Of these are some species of *moluscans;* but there are two families of a different kind, whose formation and habits demand particular notice, I mean those of the Argonaut and Nautilus. These creatures belong to an order called *Cephalapods*, because their feet are placed in the same part of their bodies as their head. The various species of this class are remarkable not only for their organization, form, and habits, but for their position in the animal kingdom. In their composition they seem to include elements from both the great divisions of that kingdom; from the vertebrates,—the beak, the eye, the tongue, an organ for hearing, the crop, the gizzard, and an analogue of the spine, with several other parts, enumerated by Cuvier; and from their own sub-kingdom, many of their remaining organs. We may descend to the very basis of the animal kingdom, for this first draught of the animal system; the sucker-bearing arms, seem to have their first outline in the fresh-water polypes; the lamellated tentacles, above and below the eyes, appear to lead to the antennæ of crustaceans and insects; and the numerous moluscan characters are obvious to every one. At the same time this singular creature exhibits many characters, both in its most extraordinary outward form, and in its internal organization, that are quite peculiar and *sui generis*, of which no animal at present known exhibits the slightest traces; I need refer only to its muscular apparatus, adapted to its unparalleled form; its system of

circulation carried on, in the first order, by three distinct organs instead of one heart; and the wonderful complication of their tentacles, of the nerves that move them, and the vascular system that animates them.

This description, which I have considerably abridged from Mr Kirby's account, shows a remarkable peculiarity in the class of animals to which the species we are considering belongs. They have each also peculiarities of their own; but they agree in one particular, that they each use their shells as boats, in which they transport themselves across the surface of the sea, erecting their sails to the wind, and plying their oars, as if they were the prototypes of the sailor and his vessel, with which he has made for himself a highway in the ocean, to unite the scattered family of man.

The shell of the argonaut, or paper nautilus, is spiral, involute, and membranous, and consists of a single apartment, or cell. It has a narrow keel, bordered on each side by a row of conical sharp tubercles; its sides are nearly flat, with numerous angular waved ridges; its colour is white, with the keel often brown. It is very thin and brittle, resembling paper in its appearance. This animal is the nautilus of the ancients. It has eight arms, two of which are furnished at the extremities with an oval membrane, which it can at pleasure raise and expand to the gale, while the other six stretch over the sides of the shell, and are used as oars. Impelled by the breeze, this little animal, in its tender bark, has the appearance of a vessel under sail, and glides along the smooth surface of the ocean.

The great chambered nautilus is a native of the Indian seas, and frequently arrives at a very considerable size. The curious structure of its shell, consisting of distinct chambers, communicating with the rest by a small and short open tube, is particularly worthy of admiration. Into this tube or syphon, a small tail-like process enters, which acts as a rudder, and instead of the tentacular legs, which distinguish the argonaut, it pro-

pels its skiff by a single expansive organ, somewhat similar to the foot of a snail.

It has been supposed by some, that the animal inhabiting the shell of the nautilus, is not its original owner, but has taken forcible possession of this commodious habitation, by destroying its original possessor. Such a supposition, however, appears to be unfounded.

Goldsmith describes this little interesting animal in his usual animated style, and, though he seems to have confounded the two different species, the following account of its sailor-like habits will not fail to be agreeable. "These animals, particularly those of the white light kind, are chiefly found in the Mediterranean, and there are scarcely any who have sailed on that sea, but must have often seen them. When the sea is calm, they are observed floating on the surface; some spreading their little sail; some rowing with their feet, as if for life and death; and others still, floating upon their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is furnished with light feet, which issue near the mouth, and may as properly be called barbs; these are connected with each other by a thin skin, like that between the toes of a duck, but much thinner and more transparent. Of these light feet, thus connected, six are short, and these are held up as sails to catch the wind in sailing; the two others are longer, and are kept in the water, serving like paddles to steer their course by. When the weather is quite calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest; whenever it is interrupted, or fears danger from above, it instantly furls the sail, catches in all its oars, turns its shell mouth downward, and immediately sinks to the bottom. Sometimes, also, it is seen pumping the water from its leaky hulk; and, when unfit for sailing, it deserts its shell entirely. The forsaken hulk is seen floating along, till it

dashes, by a kind of shipwreck, upon the rocks or the shore."

There is something which wonderfully strikes the fancy in the instincts and functions of this tiny mariner; but there is in reality nothing more remarkable in its vessel, directed by a helm, propelled by oars, or scudding under sail, than in those mechanical contrivances with which we are much more familiar, and the wisdom of which makes but little impression on our minds. That contrivances so nearly allied to those which human beings, in their skill and ingenuity, have adopted, should be found employed by the Creator to facilitate the locomotion of a sea-snail, is certainly curious and surprising; but what is there in these contrivances that indicate design more distinctly than the foot of a quadruped, or the wing of a bird? Or where shall we find, in any part of that apparatus, a skill more perfect than that which is to be discovered in the conformation of a single feather?

FIFTH WEEK—SATURDAY.

THE CORAL INSECT.

In glancing over the tribes of invertebrated animals, which form the lowest link in the scale of animal existence, another species which, on account of the singularity and importance of the structure it rears, seems worthy of arresting our attention, is the coral madrepore. Of the works of this remarkable family of the polypus class, I have already taken some notice, when adverting to the peculiar qualities of the cocoa-nut tree, as adapted to the newly-formed soil of coral islands.* A more particular description, however, will exhibit a striking proof of design, as regards the formation itself, which these animals produce.

* "Spring," p. 302. Third Edition.

Of the animal itself, very little is known. It belongs to a class, of which the sponge, and the animalcule which forms the red coral, are varieties, and all the species of which, with one exception,* attach themselves to the solid rock, being deprived of the faculty of locomotion, and, in this particular, form a link between the animal and vegetable worlds. There is no scientific description of the coral madrepore; but Vincent Rosa, an Italian, has described an animalcule of the same class, and probably of similar confirmation and habits, in the following terms. "From every cell issues a cylindrical animal, resembling an intestine, transversely wrinkled, about half an inch long, and two lines in diameter, and of which the upper extremity, or mouth, is surrounded by twenty-two very short tentacles. These animals, which are pendant, because this madrepore is always fixed under the projections of the rocks, and vibrates at the will of the waves, are always of a lively orange colour; they contract as soon as they are touched, and they die upon being taken out of the water."†

The general character of all the varieties of white coral is, that it consists of numerous radiating tubes, variously intercepted, all of which appear to issue from a common base. These are the receptacles of vast crowds of madrepores, which are busied at the surface of the formation, continually adding to the mass by their depositions, and stretching their tentacles from an innumerable aggregation of cells, to procure their food from the surrounding waters.

These tiny creatures, so insignificant individually, possess, in their collective capacity, a power which has astonished all who have turned their attention to the subject. Their countless multitudes, which are continually increasing, are incessantly at work in erecting

* The floating polipe is phosphoric, and emits so brilliant a light, that the fishermen can distinguish what fishes swim near it, and are thus directed to cast their nets.

† Quoted in Kirby's Bridgewater Treatise, vol. i. p. 180.

fabrics of amazing extent, and vast importance in the economy of Nature. It would appear, that, although they are divided into distinct individuals, they are, notwithstanding, all united together, so as to constitute one living mass, throughout the whole extent of the structure, thus forming, according to Kirby, the habitation of "a many headed and many mouthed monster, which, at every oral orifice, is collecting means of still increasing its coral palace."

Whatever truth there may be in this account, the fact is certain, that the construction of coral proceeds to a wonderful extent in the warmer climates, and especially in the South Seas.

Captain Beechy has given a most interesting account of the proceedings of these insects, in the formation of their mighty work, and he states some circumstances connected with these proceedings, which prove them to be endowed with an instinct of an extraordinary nature, indicating a wisdom and forethought only referable to that class of faculties, which has already been often brought under our notice, and which Addison describes as "an immediate impression from the First Mover, and the Divine energy acting in the creatures."

In describing a coral formation called Ducies Island, he informs us that it takes the shape of a truncated cone, with the base downward, which can be demonstrated to be the form best calculated to resist the action of the water; and he thus proceeds:—"The north-eastern and south-western extremities are furnished with points, which project under water, with less inclination than the sides of the island, and break the sea before it can reach the barrier to the little lagoon formed within it. It is singular, that these buttresses are opposed to the only two quarters whence their structure has to apprehend danger,—that on the north-east, from the constant action of the trade-wind, and that on the other extremity, from the long rolling swell from the south-west, so prevalent in these latitudes; and it is worthy of ob-

servation, that this barrier, which has the most powerful enemy to oppose, is carried out much farther, and with less abruptness, than the other."

There is another circumstance, no less remarkable, mentioned by Amoureux, a natural historian, who has paid particular attention to the operations of the coral insect. "Some," says he, "by their union or aggregation, form a long narrow ridge or reef, which extends uninterruptedly several degrees, opposing an immoveable rampart to the great currents of the sea, which it often traverses, the solidity and magnitude of which increases daily. Sometimes this line of madrepore rocks assumes a circular form. The polipes that inhabit it gradually elevate their rocky dwelling to the surface of the sea; working then in a sheltered basin, they, by little and little, fill up its voids, taking the precaution, however, to leave in the upper part of this impenetrable wall, openings by which the water can enter and retire, so as to renew itself, and furnish them with a constant supply of their aliment, and of the material with which they erect their habitation."

In reference to a Final Cause, the observations of these authors are exceedingly striking. Here is an animalcule, bound to a particular locality like a plant, and appearing scarcely to possess qualities superior to a vegetable, yet acting in concert with innumerable individuals of its species, not only to erect structures extending for hundreds of miles, but, in the mode of the combined operation, displaying an extent of scientific skill, which rivals the wisdom of the most experienced engineer, while the structures themselves incalculably exceed his power. When we observe such a society of animals not only erecting their buildings in the form best calculated to resist the force of the ocean, but even raising buttresses and breakwaters in the places most liable to be assailed, and proportioning them, with consummate art, to the force of the current they have to resist; and when we further find them, with remarkable precaution and

forethought, leaving openings, where necessary, for the entrance and reflux of the tide, so as to keep up, by a constant renovation of the waters, an accession of food and of materials for their work,—how is it possible to withhold an acknowledgment, that the instincts thus indicated are derived from an intelligence not their own?

But, if we look further, and consider the ultimate effect of these structures,—if we trace them gradually rising from the deep bed of the ocean, till they fill up vast tracks lately occupied by a waste of waters, and lay the foundation of future islands and continents, the habitation of living beings, we shall discover new grounds of surprise and adoration. That these scarcely animated polypes should be capable of effecting all this, and should, in truth, have already to a considerable extent effected it, affords a singular view of the operations of Providence, and seems to corroborate those anticipations which originate in other sources, respecting future changes in the history of the human race. From considerations arising from the extraordinary vigour of reproduction in the animal world, and of the power of human industry and skill in increasing the supply of esculent vegetables, both by their selection and by the cultivation of the soil, I have shown the probability of a further rapid and most extensive multiplication of human beings, and of animals and vegetables fitted for their use; and, in the labours of the apparently insignificant coral animalcule, there seems to be still another means by which this beneficent end may be destined to be accomplished. It is true, that the progress of coral formations is slow; but the operation is on an immense scale, proceeding, in the warmer climates, in every region, and almost in every locality, where rock is to be found at the bottom of the ocean, at such a depth as to be within the influence of the light. A few ordinary shocks of an earthquake might, according to Mr Lyell's observations, cause vast tracks of these already formed reefs and shoals quickly to emerge from the sea; and we know that, in this case, various provi-

sions, elsewhere alluded to, are made by Providence, by which they would soon be covered with vegetation, and rendered habitable. We cannot, indeed, penetrate the future intentions of the Universal Governor; but we, at all events, behold, even in the lowest view we can take, a most wonderful and interesting manifestation of benevolent action. "To me," says Mr Ellis, after an elaborate investigation of the history of living corallines, "these disquisitions have opened up new scenes of wonder and astonishment, in contemplating how variously, how extensively, life is distributed through the universe of things; and it is possible that the facts here related, and these instances of Nature animated in a part hitherto unsuspected, may excite the like pleasing ideas in others; and, in minds more capable and penetrating, lead to further discoveries,—further proofs (should such yet be wanting) that One infinitely wise, good, and all-powerful Being, has made, and still upholds, the whole of what is good and perfect."

SIXTH WEEK—SUNDAY.

THE INVISIBLE ARCHITECT.

Let us suppose that a skilful navigator, who ploughed the deep five hundred years ago, had taken soundings, and laid down accurate charts of the Southern Pacific, so that no islet, no shoal, no dangerous sunken rock, had failed to be noted by him. Let us further suppose him returned now to his ancient occupation, and afloat on his familiar waters. It would not be the new inventions about his modern rigged vessel, the skill in taking observations from the heavens, not even the occasional apparition of a ship propelled by steam, and rolling its wheels upon the unstable floor, that would most amaze him. He would gaze around on leagues, where wave succeeding wave was all that erewhile met his vision, and behold islands in which active tribes now dwell under the shade of full-grown palms, and around whose swelling headlands the many-peopled canoe darts in all the activity of commerce,—islets where the young cocoa-nut already unfolds its leaves, and groups uncounted of flat green spots just emerging from the waters,—and in places over which his ancient bark had sailed in safety, he might see and hear the foaming breaker, indicating that some new obstacle has arisen to impede the long roll of ocean, and to warn the mariner of the reef that lurks below. "Whence come all these?" cries the astonished sailor. "Has some star been shivered, and dropt its beautiful fragments into the sea, that was once so unbroken in its solitude? Have volcanic fires been at work, to heave up these blooming islands? Has some genius of mischief built these leagues of submarine dike, to work the doom of many a gallant vessel?"

Thou mayest inquire, thou ancient man, but the architect of all these fair islets will give thee no reply.

Thou mayest resume thy plummet line, and take anew thy bearings, and again form an accurate chart for the guidance of thy fellows, and then go sleep again,—and when again five centuries have come and gone, thou mayest return, and then peradventure these islands will be formed into one vast continent, of which these dangerous reefs will constitute the noble promontories, and still around its coasts will have arisen new islets and new reefs; and smiling dwelling-places, thronged with human beings, shall arise where now the white waves curl upon the briny waters. "But," says the incredulous man of the sea, "will God descend and resume the work of creation, that all this may be brought to pass?" No, the Creator will not resume his creation-work, he will only continue to exercise his preserving power, and his architects will accomplish all this. "Still the architect appears not,—who and where is he?" He is a mason, who not only uses stones for His building, but produces them. He knows nothing of mortar, or of cement, and yet His walls are as adamant. He has neither plane, nor chisel, nor trowel; there is no sound of hammer in His city. He erects edifices loftier than the Pyramids, yet has no mechanical power by which to raise His rocks to their summits. He can answer thee nothing,—no tongue, no eyes, no hands, no brains, has he, yet from the caves of old ocean has he raised that which fills you with admiration. Let me describe him, that you may admire with me the wonderful work of God.

He is a being scarcely belonging to the animal creation,—a minute pouch of organized matter, with no organs, save a few tentacles surrounding his mouth;—yet with these he is able to secrete calcareous particles from food collected amid the waters, and to transpire or regurgitate them so as to construct a limestone house. He is also empowered perpetually to send forth germs that repeat the same action; and thus, in process of time, by the combined efforts of millions, are groups of islands built up in the midst of the fluctuating ocean, which

eventually arrive at the climax of their purpose, by becoming the permanent abode of man himself.

Here is, indeed, a marvellous edifice, and an invisible architect,—a process continually advancing, unaided and unnoticed by the world. But there is a more mysterious edifice, which has been in progress for six thousand years,—an edifice permanent and beautiful, of which the world takes no account. Would you see it? It is but in fragments here. Its chief,—its foundation-stone was long since cut out of the mountain, without hands. The living stones with which its walls are built, are hewn and fitted in the quarry:—all their irregularities being there smoothed away, all their rough places broken off, they are polished and rendered beautiful before they are removed to be placed in the walls of that living temple, of which Solomon's was but a feeble type. But what, ask you, is this noble temple? and where is the busy quarry out of which its stones are hewn? Reader, it is "God's building!" This world is the quarry;—you are perhaps yourself, or, at all events, you may, if you will, become one of those living stones, built up into a spiritual house. Have you ever been moulded under the warnings or invitations of the word of life? It is because the Master Builder has shed an effusion over the stone of your hard heart, and, thus prepared, it has yielded to the hand of the workman. Has conscience become quickened by the power of conviction, and rent off some darling sin? Then was a visible alteration produced in the surface of the stone. Has calamity broken away some inveterate evil, and left you suffering, but ductile, and praying, "Lord, what wilt thou have me to do?" Then may you well believe that you are in the hands of the Workman, and that the process of fitting you for the spiritual building is going on in earnest. Take heed to it, watch for it, pray over it, lest the work be impeded, and the Master Builder cease to apply his forming hand to you. Muse much on that living temple:—Its foundation is laid in atoning blood,

—blood shed for *many*;—and why not for you? Salvation it has for walls and bulwarks;—and there all the saved shall find their appropriate place. But if the builders of the temple on Mount Zion would have rejected a stone, whose proportions or whose polish failed to suit the designed place, how much more will the Holy One reject from among his living stones, any one whose dispositions and whose delights are unsuited to the heavenly edifice! In Christ Jesus, himself being the chief corner-stone, is all the building fitly framed together, and groweth unto an holy temple in the Lord; in whom all who love him are builded together for an habitation of God through the Spirit.

The work is silent, the world heeds it not; or if it heard, believes not in its reality; or again, if its reality is forced upon its conviction, it puts forth impious hands to pluck it down. But the building grows apace. The eye of God is not withdrawn from his designed and glorious habitation. If each stone of that wondrous work is "living,"—each instinct with the conscious presence and approbation of the Deity,—each a temple for the Holy Spirit to inhabit, what must the grand united and completed temple be? Let not your heart die within you at the thought, as if you never could have an assigned place there. The scarcely living coral insect erects many a palace in the fathomless deep, because his Creator aids him,—he applies his powers to that for which they are designed, and prospers;—and will not God the Redeemer prosper you, when you apply yourself to do that for which you were bought with a price, namely, to "glorify him in your body and in your spirit, which are God's?"

As little will a single Christian, persecuted it may be, or tempted, or at best "faint, yet pursuing," give us a clear idea of the church triumphant, as a single cornice or pillar will represent the Vatican, or the labour of a single coralline enable us to form an idea of the far-extending submarine labours of a colony of these animal-

cules. Examine the coral insects alone, and suppose each individual to act independently of the rest, and they will appear as nothing. Imagine them departing from their coral cradle, and diverging to right and left at the bottom of the deep, they might toil there till the world had become hoary, they might spread themselves over the sands and rocks, as a carpet of moss is extended over the bosom of a mountain; but they would not ascend to the surface of the waters; they would form no islands. Or supposing them building each alone, or in feeble communities, their paltry edifices would be snapt in sunder by every billow, and themselves dispersed, to form other and still feebler settlements in other localities.

This forms too correct a representation of the church militant. Instead of being joined in one spirit to our head, we are subdivided, estranged, imbittered, enfeebled. Instead of having the simple design, which we follow with singleness of heart, to strive for the extension of the edifice, until the whole world produce living stones, we are distracted by some inferior design, which we place foremost, because it is our own, or of our own contriving. Instead of looking steadfastly to Him who is the corner-stone, and aiming to extend His glory to the ends of the earth, our efforts are cramped, and our strength paralyzed by upholding some Apollos or Cephas, who fills so large a section of our vision, as almost to exclude the view of the Redeemer.

Would that men aimed at the simplicity of purpose, and power of combination, which produce such amazing results in the insignificant coralline. Then how swiftly would that house not made with hands be completed! Then how many, who are now left unhewn in the quarry, would come forth as living stones! Then how soon would that glorious consummation be achieved, on which the eye of the Master Builder is set, and "the headstone of the building be brought forth with shoutings of Grace, grace unto it!"

M. G. L. D.

SIXTH WEEK—MONDAY.

INSECT TRANSFORMATIONS.—THEIR COCOONS.—THE SILK-WORM.

The transformations which terrestrial insects undergo in the course of their existence, have been frequently alluded to in the preceding volumes; and some of them have been described, in reference to their hybernation and reproduction. The subject, however, is at once copious and interesting; and as this is the season when many of these metamorphoses take place, I willingly recur to it.

The first process to which I shall advert, as connected, in many insects, with these transformations, is that by which they prepare for themselves a shroud of silk for their temporary retreat, during the insensible state into which they are thrown while undergoing their most important changes. It is interesting to observe the various ways in which similar contrivances are adapted by the Creator to the fulfilment of different purposes. The spider, as we have seen, spins and weaves nets to entrap her prey,—she also spins cocoons for her eggs; while all the caterpillars of butterflies, of moths, and, in general, of insects with four wings, spin silk of various degrees of fineness and strength, for enveloping their bodies like mummies, while in the chrysalis state.

In order to understand the nature of the apparatus by which a caterpillar spins its silk, it is to be recollected, that its whole interior structure differs from that of warm-blooded animals. It has, properly speaking, no heart, though a long tubular vessel, which runs along the back, and beats from twenty to a hundred times in the minute, has been called so. It differs also from the higher orders of animals, in having no brain, the nerves running along the body being only united by little knobs, or ganglions; and no lungs, their office being

supplied by eighteen spiracles, situated along the sides. The spinning apparatus is placed near the mouth, and is connected with the silk bags, which are long, slender, floating vessels, containing a liquid gum. The bags are closed at their extremity, become wider toward the middle, and more slender toward the head, where they unite to form the spinning-tube or spinneret. The bags being in most cases longer than the body of the caterpillar, necessarily lie in a convoluted state, like the intestines of quadrupeds.

The following observations, by the Abbé de la Pluche, will explain the nature and use of the spinneret:—"You may sometimes have seen, in the work-rooms of goldsmiths or gold-wire-drawers, certain iron plates, pierced with holes of different calibres, through which they draw gold and silver wire, in order to render it finer. The silk-worm has, under her mouth, such a kind of instrument, perforated with a pair of holes,* through which she draws two drops of the gum that fills her two bags. The instruments are like a pair of distaffs, for spinning the gum into a silken thread. She fixes the first drop of gum that issues, where she pleases, and then draws back her head, or lets herself fall, while the gum continuing to flow, is drawn out and lengthened into a double stream. Upon being exposed to the air, it immediately loses its fluidity, becomes dry, and acquires consistence and strength. She is never deceived in adjusting the dimensions of the apertures, or in calculating the proper thickness of the thread, but invariably makes the strength of it proportionable to the weight of her body."†

The silk-worm, to a description of which I intend at present to confine myself, like most other moths, changes its skin four times during its growth, at which times it

* These two holes Lyonnet has discovered, on minute inspection, to be united into one. He has also discovered, that the united tube has a power of contraction and expansion, by which the insect can make the silk coarser or finer at pleasure.

† Spectacle de la Nature, vol. i.

attaches itself, by its silk, to the place where it happens to be reposing, evidently to prevent the accident of wind or other causes from disturbing it while the operation of sloughing proceeds. About ten days after the fourth moulting, before which it has attained its full growth, and subsequent to which it has ceased to eat, and begun to diminish in size, having carefully sought for itself a safe retreat, it commences the operation of spinning itself a shroud. The author above quoted, gives the following description of this operation :—

" When my curiosity led me to know how they spun and placed their beautiful silk, I took one of them, and frequently removed the floss with which it first attempted to make itself a covering ; and, as by this means I weakened it exceedingly, when it at last became tired of beginning anew, it fastened its threads on the first thing it encountered, and began to spin very regularly in my presence, bending its head up and down, and crossing on every side. It soon confined its movements to a very contracted space, and, by degrees, entirely surrounded itself with silk, and the remainder of its operations became invisible, though these may be understood, from examining the work after it is finished. In order to complete the structure, it must draw out of the gum-bag a more delicate silk, and then, with a stronger gum, bind all the inner threads over one another.

" Here, then, are three coverings, entirely different, which afford a succession of shelter. The outer loose silk, or floss, is for keeping out the rain ; the fine silk in the middle, prevents the wind from causing injury ; and the glued silk, which composes the tapestry of the chamber where the insect lodges, repels both air and water, and prevents the intrusion of cold.

" After building her cocoon, she divests herself of her fourth skin, and is transformed into a chrysalis, and subsequently into a moth *(Bombyx mori)*, when, without saw or centre-bit, she makes her way through the

shell, the silk, and the floss; for the Being who teaches her how to build herself a place of rest, where the delicate limbs of the moth may be formed without interruption, instructs her also how to open a passage to escape."

After giving some further minute particulars, the Abbé thus describes the change from the state of a chrysalis to that of a moth:—"Its nourishment is already in its stomach, and consists of a yellowish mucus, but gradually the rudiments of the moth unfold themselves,—the wings, the antennæ, and the legs, becoming solid. In about a fortnight or three weeks, a slight swelling in the chrysalis may be remarked, which at length produces a rupture in the membrane that covers it, and, by repeated efforts, the moth bursts through the leathery envelope into the chamber of the cocoon." It thence forces its way into the open air.

It is the middle portion of the cocoon, after removing the floss or loose silk on the exterior, which is used in our manufactures. The insect must spin the whole of this without interruption, as we learn from the fact of the cocoons being generally unwound without breaking the thread. The length of an unbroken thread varies from 600 to 1000 feet; and as it is all spun double by the insect, it will amount to nearly 2000 feet of silk, the whole of which does not weigh above three grains and a half. Five pounds of silk from 10,000 cocoons, is considerably above the usual average. When we consider, therefore, the enormous quantity of silk which is used at present, the number of worms employed in producing it will almost exceed our comprehension. The manufacture of silk, indeed, gives employment, and furnishes subsistence, to several millions of human beings.*

* The silk trade of Great Britain at present may be valued at £7,000,000 Sterling. The silk importations from France, through our Custom-house, amount to from £150,000 to £500,000; and by smuggling, to £250,000 or £300,000 more, making in all from £750,000 to £800,000. Manufactured silk, to the amount of £6,000,000 Sterling, is consumed in this country

In ancient times the manufacture of silk was confined to the East Indies and China. The origin of this useful and beautiful substance was altogether unknown to the Roman authors, who have given ear to the most ridiculous fables respecting it. The insects at last were transported to Persia, and the Emperor Justinian introduced them into Constantinople, having obtained them by means of two monks, who concealed them in canes, and conveyed them to the island of Cos.

The scarcity of silk at no very distant date, is amusingly enough exemplified by the fact, that James I., before his accession to the crown of England, had to borrow of the Earl of Mar a pair of silk stockings to appear in before the English ambassador. The culture of silk, as an article of commerce, has been attempted in this country, but without success. It was successively introduced into Greece, Arabia, Spain, Italy, and France. It has also found its way into America, and is successfully cultivated in almost all the southern countries of the temperate zone. How curious is the Providential provision, by which a little insect, in following a natural instinct for its own preservation, is the means of furnishing to man one of his most esteemed and ornamental articles of clothing. It is, however, quite analogous to many other arrangements by which the comfort and improvement of the human race are promoted.

SIXTH WEEK—TUESDAY.

INSECT TRANSFORMATIONS.—THEIR LARVA STATE.

The first state in which an insect appears when it is separated from the egg, is that of a caterpillar or grub, or of a maggot or worm, the former being furnished

alone. What must be the amount throughout the world!—See *Ure's Philosophy of Manufactures*, pp. 246, 247.

with feet, and the latter not. Both are by naturalists called *larvæ*. I shall not enter into any scientific details as to the nature of the animal in this state, but shall confine myself to the mention of one or two curious particulars.

With regard to the general appearance of the common caterpillar tribe, it is not easy to give a description which will answer them all. One of the most conspicuous of the class is thus graphically portrayed by Isaac Walton. "The very colours of caterpillars, as one has observed, are elegant and beautiful. I shall, for a taste of the rest, describe one of them,* which I will sometime the next month show you feeding on the willow-tree, and you shall find him punctually to answer this very description; his lips and mouth somewhat yellow; his eyes black as jet; his forehead purple; his feet and hinder parts green; his tail two-forked and black; the whole body stained with a kind of red spots, which run along the neck and shoulder blade, not unlike the form of St Andrew's cross, or the letter X, made cross-wise, and a white line drawn down his back to his tail; all which adds much beauty to his whole body."—"And it is to me observable," this pleasing old writer continues, "that at a fixed age this caterpillar gives over to eat, and towards winter comes to be covered over with a strange cell or crust, called an *aurelia*, and so lives a kind of dead life, without eating all the winter. And as others of several kinds turn to be several kinds of flies and vermin the spring following, so this caterpillar then turns to be a painted butterfly."†

But there is another kind of *larva*, called a water-grub, whose history is still more remarkable. One species is the produce of the gnat, the extraordinary instinct of which, in constructing a boat of its eggs, I have elsewhere described.‡ These eggs fall to the bottom of the water, where they remain till they are hatched.

* The prest-moth. † Walton's Angler, chap. v.
‡ "Spring," p. 137. Third Edition.

They then become grubs, whose element is the water. Their organs for breathing, which are very singular, are not situated in the head, as in the higher species of animals, nor in the sides, as in caterpillars, but in the tail. A tube, for the purpose of respiration, goes off from the terminal ring of the body at an angle. Its main buoys are this tube and its tail, both of which end in a sort of funnel, composed of hairs, in form of a star, anointed with oil, so as to repel the water. It is thus suspended with its tail upward, so as to reach the surface, and its head constantly immersed to the extent of its body in the water, where doubtless it procures its supplies of nourishment. If the oil be removed from these hairs, the grub will sink to the bottom. "I have on these occasions," says Swammerdam, "observed it put its tail in its mouth, and afterwards draw it back, as a water-fowl will draw its feathers through its bill to prepare them for resisting water."* The air, which enters into several openings in the breathing tube, passes onwards to two lateral windpipes, very similar to those of caterpillars. When it wishes to descend to the bottom of the water, it folds up the hairs of the funnel; but by means of its oil retains at their ends a globule of air; and when it wishes to re-ascend, it has only to open its air-funnel again.

There are other flies besides the gnat, whose grubs are aquatic, and one is mentioned by Swammerdam, that of the cameleon fly, whose air-funnel is extended to a considerable length from its terminal ring, and is fringed at the end with a beautiful star-like funnel of thirty feathers. These repel water like those of the gnat-grub, and at the point where the insect hangs suspended, a small dimple may be observed in the surface of the water. This grub also carries a globule of air with it, for the purpose of breathing, enclosed in its brush, when it descends to the bottom, which may be seen there, shining like a brilliant pearl.

* Biblia Naturæ, Part 1st, p. 154.

There is another two-winged fly, the grub of which seeks its food among ooze and mud, and whose breathing tube, while in the larva state, can at pleasure be elongated to twelve times the length of its body; the obvious intention being to keep up a communication with the external air, at such depth as is necessary for it while seeking its food. "For my part," says the naturalist above-mentioned, "I dare boldly affirm, that the incomprehensible greatness of the Deity, manifests itself in these operations in a particular manner, and affords us an opportunity of examining, as it were, with our senses, the Divine Nature."*

The larvæ of the dragon-fly procure air below the water, partly by means of an apparatus for pumping, and the water thus drawn in is thrown out again at its tail, with such force as to serve,—by the resistance of the stationary mass of water, and by creating a counter current,—as the means of its moving from place to place; while the reverberatory stream brings small water-insects within its reach. I have mentioned this grub, chiefly for the purpose of introducing an amusing account, given by Kirby and Spence, of the instruments by which it secures and masticates its food. "The underlip is by far the largest organ of its mouth, which, when closed, it entirely conceals, and the animal not only retains, but actually seizes its prey, by means of a very singular pair of jaws, with which it is furnished. Conceive your underlip to be horny instead of fleshy, and to be elongated perpendicularly downwards, so as to wrap over your chin, and to extend to its bottom,—that this elongation is there expanded into a triangular convex plate, attached to it by a joint, so as to bend upwards again, and fold over the face as high as the nose, concealing not only the chin and the first mentioned elongation, but the mouth and part of the cheeks; conceive, moreover, that, at the upper end of this last-mentioned plate, are placed other convex

* Swammerdam, Part 2d, p. 51.

ones, so broad as to cover the whole nose and temples ;—that these can open at pleasure transversely like a pair of jaws, so as to expose the nose and mouth ; and that their minor edges, where they meet, are cut into numerous sharp teeth or spines, or armed with one or more sharp claws ;—you will then have as accurate an idea as my powers of description can give of the strange conformation of the underlip of the larvæ of the *Libellulina* [the dragon-fly], which conceals the mouth and face, precisely as I have supposed a similar construction of your lip would do yours. You will probably admit that your own visage would present an appearance not very engaging, while concealed by such a mask ; but it would strike still more awe into the spectators, were they to see you first open the two upper jaw plates, which would project, from each temple, like the blinders of a horse ; and next, having by means of the joint at your chin, let down the whole apparatus, and uncovered your face, employ them in seizing any food that presented itself, and conveying it to your mouth. Yet this procedure is that adopted by the larva of the dragon-fly, provided with this strange organ. While it is at rest, it applies close to and covers the face. When the insects would make use of it, they unfold it like an arm, catch the prey at which they aim by means of the mandible, form plates, and then partly refold it, so as to hold the prey to the mouth in a convenient position, for the operation of the two pairs of jaws with which they are provided. Reaumur once found one of them thus holding and devouring a large tadpole."

These lively writers, in speaking of the mask-like appearance of this apparatus, jocosely add, " If entomologists ever went to masquerades, they could not more effectually relieve the insipidity of such amusements, and attract the attention of the *demoiselles*,* than by appearing at the supper-table with a *mask* of this construction, and serving themselves by its assistance." For my

* Alluding to the French name of the dragon-fly.

part, I am inclined to take a more serious view, and considering these varied and wonderful contrivances and adaptations, as new proofs of Creative Wisdom, to bend in admiring adoration before Him whose works are so manifold, and whose resources are at once so skilful and so inexhaustible. "Who knoweth not in all these that the hand of the Lord hath wrought this!"

SIXTH WEEK—WEDNESDAY.

INSECT TRANSFORMATIONS.—THEIR PUPA OR CHRYSALIS STATE.

"COUNTRY fellows, for a prize," says Kirby, "sometimes amuse the assembled inhabitants of a village by running races in sacks: take one of the most active and adroit of these, bind him hand and foot, suspend him by the bottom of his sack, head downward, to the branch of a lofty tree; make an opening in one side of the sack, and set him to extricate himself from it, to detach it from its hold, and suspend himself by his feet in its place. Though endowed with the suppleness of an Indian juggler, and promised his sack full of gold for a reward, you would set him on an absolute impossibility; yet this is what our caterpillars, instructed by a beneficent Creator, easily perform."*

I have already shown how the silk-worm prepares for its pupa state, by weaving for itself a shroud; and this may be taken as an example of the process pursued by several other species of larvæ, such as those of the press-moth, the tentmakers, &c.; but the curious operations alluded to by Kirby, in the passage I have quoted, are most commonly employed by the insect tribes in the stage of transformation we are now considering. They suspend themselves by means of almost invisible silken filaments, formed into a little button thickly interlaced and strong, which they weave for themselves, and

* Introduction, III. p. 209.

among the meshes of which they thrust their hinder pair of prolegs; taking secure hold by the numerous hooks with which these are fringed, and then fearlessly swinging themselves into the air with their heads downward. The most difficult part of the process still remains; for the insect has to throw off its skin while thus suspended, together with the hooks by which it is attached, and this without losing its hold. The old skin is rent by the forcible bending round of the upper part of the body, a tedious and probably painful operation, in which it is engaged for a day, or sometimes even more. The rent being made, the included insect, by successively contracting and dilating the rings of its body, pushes off the skin by degrees from the head towards the tail, as the sack-racers mentioned by Kirby would disengage themselves from the sacks in which they are enclosed.

In this position the excluded insect is at a considerable distance from the point of attachment to the meshes of silk, hanging on the empty slough. It has to reach that point, fix itself there, and disengage and cast away the sloughed skin. This operation, says Bonnet, causes a spectator to tremble for the consequences, for every moment seems to render its fall almost certain. It is, however, provided with means which enable it to effect its purpose: it can elongate and contract, at pleasure, the rings of its body. Laying hold of the nearest portion of the skin between two of its rings, as with a pair of pincers, it securely crawls along it, till it reaches the silk button. Having arrived at this station, it feels about with its tail for the silk, and inserts into its meshes the delicately formed hooks with which that part of its body is furnished; when, finding itself securely fixed, it again throws itself into the air, and hangs as formerly, with its head downward. It yet remains that the old skin be got rid of, the neighbourhood of which appears to be annoying. This it effects by repeated wrigglings, gyrations, and contortions of its body,

which disengage the hooks of the prolegs from the silk, and cause it to fall to the ground.

There are other insects, which, manifesting the variety of resources belonging to the Author of Nature, make use of other expedients. Some of these not only fix themselves by the tail, but throw around their body, by a curious process, a girdle of silk, which binds them firmly to the spot selected, frequently in a horizontal position. But instead of stopping to detail this difficult operation, which is performed in a different manner by distinct classes, I shall select an order whose plan of proceeding is altogether dissimilar. I allude to the numerous species of what are called common flies. Unlike most other larvæ, these never cast the skin, not even when they change into pupæ. The maggot of the common blow-fly, for example, when about to undergo its transformation, quits the carrion on which it has been feeding, and burrows, for an inch or two, into the first soft earth it can meet with. Here it draws in its body into a shorter compass, and the soft skin being thus condensed, it acquires in thickness what it loses in length. In this state it becomes hard and tough, like thin parchment, and of a dull reddish-brown colour. Within this skin, now converted into a leathern case, it undergoes its transformations, which have been minutely traced by Reaumur, but which I shall not enumerate, as this would lead into a somewhat tedious detail.

We are apt to consider the processes of insect transformation as insignificant, merely on account of the smallness of the animal, that it is sometimes desirable to suppose a case in which bulk would appear to yield to their importance. Mr Bonnie has, in the present instance, successfully availed himself of this device:—"Were such an extraordinary transformation as this," says he, "to happen to one of the larger animals, it would be held forth as altogether miraculous. Were a lion or an elephant, for example, to roll itself up into a ball, compressing its skin into twice the thickness, and

half the extent, while it remained uniform in shape, and without joinings or openings; and, at the same time, were it entirely to separate its whole body from this skin, and lie within it as a kernel does in a nut, or a chick in an egg, throwing off its now useless tusks into a corner,—and then, after a space, should it acquire wings, break through the envelope, and take its flight through the air, there would be no bounds to our admiration. Yet the very same circumstances, in miniature, take place every day during summer, almost under the eye of every individual, in the case of the blow-fly, without attracting the attention of one person in a million."*

Were we to follow up this idea, by supposing the various tribes of the insect world magnified to the dimensions of man, and the vertebrated animals, with which he is immediately associated, we should acquire more distinct views of their relative powers; but what a scene of wonders would be disclosed to our view. It would be pleasant to give way to our fancy in peopling the world with the monsters—strange and diverse, which would then meet us on every side. Looking only to one of the species we have been considering, we should see a creature large and fearful as a crocodile, for a time consuming every thing before it with the voracity of a hundred cattle, but presently becoming sick and refusing to eat; and then climbing the highest trees, spinning ropes from its bowels, weaving a net, and hanging itself up by the feet to the winds of heaven; and then again bursting its natural covering, coming forth to the open air, naked and in a new shape, and, in resuming its position, discovering a tact and agility which neither man nor quadruped could equal; once more we would observe this wonderful animal voluntarily suspended at the giddy height it had first assumed, and remaining exposed to the changing season till a new metamorphosis took place. Again it bursts its external covering; and

* Insect Transformations, p. 262.

now it comes forth a glorious being, shining with sapphire, emeralds, and gold, expanding its painted wings in the sun, and soaring joyously through the yielding air. Such would be the history of one class of existences; and a hundred more, equally surprising and extraordinary, would meet our view on every side.

But instead of pursuing this train, let us look at some of the faculties and operations of the insect tribes as compared with those of higher species. The flea can draw seventy or eighty times its own weight,* and it can leap to the distance of 200 times its own length. It is, therefore, immensely stronger than a horse, in proportion to its size; and were a man able to equal the agility of this little animal, he could leap between 300 and 400 yards. But the cuckoo-spit froghopper has still greater elasticity of limbs, being able to leap more than 250 times its own length; and, to vie with this, a man of ordinary stature should vault through the air to the distance of a quarter of a mile! It has been remarked, that according to a similar mode of comparison, a cockchaffer is six times stronger than a horse; and Linnæus observes, that if an elephant were as strong in proportion as a stag-beetle, it would be able to tear up rocks and level mountains. The architecture of insects is not less remarkable than their strength and agility. It has been said, that the community of white ants erect a building 500 times their own height. Were our houses built on the same proportions, they would be twelve or fifteen times higher than the London Monument, and four or five times higher than the Pyramids of Egypt,

* Many wonderful exhibitions of the strength of the flea have been made, one of the first of which was in Cox's museum, about sixty or seventy years ago. Mr Boverich, a London watchmaker, constructed a minute landau, which opened and shut by springs, with the figures of six horses harnessed to it, and of a coachman on the box, a dog between his legs, four persons inside, two footmen behind it, and a postillion riding on one of the four horses, which were all easily dragged along by a single flea. Goldsmith remarks, that the feats of Samson would not, to a community of fleas, appear to be at all miraculous.

with corresponding dimensions at the base: to such buildings St Paul's would be but as a bee-hive!

"The minute observation," says Mr Rennie, in stating comparisons of this kind, "by which such unexpected facts are discovered, has in all ages been a fertile source of ridicule for the wits, from the time when Aristophanes in his 'Clouds' introduced Socrates measuring the leap of a flea, up to Peter Pindar's lampoon on 'Sir Joseph Banks and the Emperor butterfly.' To all such flippant wit, we have merely to retort the question of the Abbé de la Pluche,—'If the Deity thought insects worthy of his divine skill in forming them, ought we to consider them beneath our notice?'"*

SIXTH WEEK—THURSDAY.

INSECT TRANSFORMATIONS.—THEIR IMAGO OR PERFECT STATE.

While the insect is in its chrysalis state, the future fly is gradually formed and developed, and at last it again emerges to the light of day, by throwing off its external covering. The manner in which this is effected is far from uniform, but is suited, in each species, with remarkable care, to its individual peculiarities. The very singular manner in which the aquatic pupa of the gnat disengages itself on the surface of the water, making use of its coffin, during the operation, as a boat, has already been described.† One other instance may be mentioned, premising that most insects liberate themselves without external aid, being assisted by various prospective contrivances, among which may be named the swelling of their bodies, which breaks their coverings at some convenient place, and enables them to make use of their natural conformation in emerging, their bodies being generally composed of rings, which can be contracted or expanded at pleasure. The case I select is

* Insect Transformations, p. 180. † "Spring," p. 134. Third Edition.

that of the ant; and I do so, because it affords an example of an insect which, being incapable of extricating itself from its pupa shell, is indebted for assistance, in this last change, to the already liberated inhabitants of the same nest. The younger Huber, in describing these pupæ, which are enclosed in a tissue spun by themselves says, "they have scarcely the power of moving; their covering is of too compact a texture, and formed of too strong a silk, to allow of their tearing it, without the assistance of the workers. But how do these indefatigable attendants ascertain the proper moment for this process? If they possessed the faculty of hearing, we might imagine they knew the fit time, from some noise produced in the interior of the prison, by the insects whose development is commenced; but there is no indication favouring this opinion; it is probable they have a knowledge of it from some slight movements that take place within, which they ascertain through the medium of their antennæ; for these organs are endowed with a sensibility of which it would be difficult to form a just idea."

The following is the manner in which, as described by this author, the ants were observed to proceed:—"I noticed three or four, mounted on one of these cocoons, endeavouring to open it with their teeth, at that extremity answering to the head of the pupa. They began to thin it, by tearing away some threads of silk, where they wished to pierce it; and at length, by dint of pinching and biting this tissue, so extremely difficult to break, they formed in it a vast number of apertures. They afterwards attempted to enlarge these openings by tearing and drawing away the silk; but these efforts proving ineffectual, they passed one of their mandibles into the cocoon, through the apertures they had formed, and, by cutting each thread, one after the other, with great patience, at length effected a passage of a line in diameter in the superior part of the web." They afterwards cut out a portion in the longitudinal direction of the cocoon.

with their teeth alone, employing them as we employ scissors; and, as the work of extrication is a task of great labour, the ants relieved one another, till at last they were enabled to draw out the insect from its imprisonment. Their toil, however, was not yet completed; for the young ant, being enwrapped in another membrane, "could neither fly nor walk, nor, without difficulty, stand." Of this satin-like investment it was likewise stripped by the indefatigable assiduity of its followers; and, to crown all this care, which maternal attentions alone could equal, the first object of these kind guardians, was to supply the craving appetite of their young charge with necessary food.*

The providential intention of this arrangement is remarkable. The grub of the ant might doubtless have been formed with the power of extricating itself from its cocoon as well as the grubs of other insects; but, as it is destined to live in a community, all the members of which are united together for the common welfare, it seems to have been designed, by the instinct that has been noticed, and the necessity which required it, to form a bond between the young of the republic, and their seniors, which, from the first moment of their final transformation, should connect them together by those strong and tender sympathies that subsist among benefactors and the benefited. Such arrangements among animals living in community are not rare. We may trace them, in a greater or less degree, through all those tribes which associate together for a common interest, beginning with man himself; and they very strangely indicate not only the forethought but the benevolence of Him who has instilled the social instinct, and caused it to be productive of enjoyment to so many orders of beings.

As soon as the insect is extricated, it is found, in by far the greater number of instances, extending not only to many species, but also to numerous orders, to be fur-

* Huber on Ants, p 88.

nished with wings, and destined to find its way through the atmosphere. That little creature which had hitherto grovelled in the earth, and whose powers of locomotion were so limited, has now acquired a power by which it can readily transport itself to considerable distances from place to place, and obtain varied enjoyments, to which, in the earlier stages of its existence, it was altogether a stranger. To this new condition some very peculiar circumstances are necessary; among these buoyancy is one of the most obvious. We have already seen how this is provided for in birds.* Something similar, but corresponding to the peculiarities of their conformation, is found also in insects. It is by means of internal air-vessels that the requisite degree of lightness is obtained. We may not be able to trace very distinctly the peculiar mechanism by which this is effected, by reason of the minuteness of the organs; but one of the most remarkable phenomena which distinctly mark its existence, is the expansion of the body and wings, on the extrusion of the perfect insect from its pupa case. A very striking exemplification of this occurs in the transformation of the ant-lion, whose singular instincts are so well known. When this creature has emerged from its cocoon, it only requires to expand its wings and body, in order to complete its transformation; but this is a process calculated to excite our highest admiration; for, though it is not at first more than half an inch in length, it almost instantaneously stretches out to an inch and a quarter, while its wings, which did not exceed the sixth part of an inch, acquire an immediate expansion of three inches.†

A similar increase of size is observable, to a greater or less degree, in all the insect tribes which rise into the air; and it is doubtless effected by the introduction

* "Spring." Third Edition.—Relation of the Bodies of Birds to External Nature, p. 180.

† The *lace-winged* fly exhibits a still more remarkable and not less sudden growth. The pupa of this insect is not bigger than a small pea, while the fly is nearly an inch in length, and the expanse of the wings about two inches.

of air into the receptacles of the body. Thus they become exceedingly light, in proportion to their bulk, and their power of floating in the atmosphere is greatly facilitated.

The expansion of the wings is also a subject worthy of observation. They are folded up, and sometimes doubled, in a very compressed state, while they remain in the chrysalis; but presently assume extraordinary dimensions, when exposed to the air. In the instance of the silk-worm moth, "they expand so rapidly that it is not easy to trace their unfolding; for, in the space of a few minutes, they increase in dimensions about four-fold. Their spots and colours, at the same time, previously so small as to be scarcely discernible, become proportionally extended; so that, what, but a few minutes before, appeared as a number of confused and indistinct spots, acquires many varied beauties of colour and form."*

The motions of insects, indicating enjoyment, are very remarkable; and, from this circumstance, Paley, with his usual felicity, has drawn an argument for the benevolence of the Deity. The following extract from a very interesting account, by Reaumur, of the appearance of the day-flies, or *ephemeræ*, on the banks of the Seine, illustrates the same truth. These insects are destined to live but a few hours, yet their brief time seems full of ecstatic enjoyment. "The countless numbers of ephemeræ," says he, "which swarmed over the water, can neither be conceived nor expressed. When snow falls thickest, and in the largest flakes, the air is never so completely full of them as that which we witnessed filled with ephemeræ." It was evening; and Reaumur procured a torch which at once attracted them, and advantageously showed their gyrations. "The light of the torch gave origin to a spectacle which enchanted every one who beheld it, and was altogether different from a meteorological shower; even the most stupid and unobserving of my domestics were never satisfied with gazing

* Insect Transformations, p. 341.

at it. No armillary sphere was ever formed of so many circular zones, in every possible direction, having the light for their common centre. Their number seemed to be infinite, crossing each other in all directions, and in every imaginable degree and inclination, all of which were more or less oblique. Each of these zones was composed of an unbroken string of ephemeræ, which followed each other close in the same line, as if they had been tied together head and tail, resembling a piece of silver ribbon, deeply indented on its edges, and consisting of equal triangles placed end to end; so that the angles of those that followed, were supported by the base of those which preceded, the whole moving round with incredible velocity. This spectacle was caused by the wings of the insects, which alone could be distinguished. Each of these flies, after having described one or two orbits, fell to the earth, or into the water, though not in consequence of having been burned."* Nothing could more distinctly indicate extreme delight, which seemed to end only when the joyous beings ceased to feel.

SIXTH WEEK—FRIDAY.

THE BUILDING SPIDER.

From considering the transformations of the insect tribes, we ascend to the instincts and habits of those varied and interesting families, and the first of these which I shall select for examination is the spider. There are several species of this remarkable insect, most of them possessing some peculiarity of habits, or organization, by which they are distinguished; but among these there is none either more singular, or better calculated to exhibit a proof of Designing Wisdom, in its instincts, than that class which has acquired the appropriate name of the trap-door or building spider. I shall follow the

* Reaumur, Mem. vol. vi. p. 480.

account of the celebrated M. V. Audoin, as abridged by Mr Kirby in his Bridgewater Treatise.*

Some species of spiders, M. Audoin remarks, are gifted with a particular talent for building: they hollow out dens; they bore galleries; they elevate vaults; they build, as it were, subterranean bridges; they construct, also, entrances to their habitations, and adapt doors to them, which want nothing but bolts; for, without any exaggeration, they work upon a hinge, and are fitted to a frame.

The interior of their habitation, he continues, is not less remarkable for the extreme neatness which reigns there; whatever be the humidity of the soil in which they are constructed, water never penetrates them; the walls are nicely covered with tapestry of silk, having usually the lustre of satin, and almost always of a dazzling whiteness. He mentions only four species of the genus as at present known;—one which was found in the island of Naxas; another in Jamaica; a third in Montpellier; and a fourth, that which is the subject of his Memoir, in Corsica; to which I may add a fifth species, found frequently by Mr Bennett, in different parts of New South Wales.

The habitations of the species in question are found in an argillaceous kind of red earth, in which they bore tubes about three inches in depth, and ten lines in width. The walls of these tubes are not left just as they are bored, but they are covered with a kind of mortar, sufficiently solid to be easily separated from the mass which surrounds it. If the tube is divided longitudinally, besides this rough-cast, it appears to be covered with a coat of fine mortar, which is as smooth and regular as if a trowel had been passed over it. This coat is very thin, and soft to the touch. But, before the adroit labourer lays it, she covers the coarser earthy plaster-work with some coarse web, upon which she glues her silken tapestry.

* Vol. ii. pp. 287-293.

All this shows, that she is directed in her work by a wise Master; but the door that closes her apartment is still more remarkable in its structure. If her well was always left open, she would be subject to the intrusion of guests, that would not, at all times, be welcome or safe. Providence, therefore, has instructed her to fabricate a very secure trap-door, which closes the mouth of it. To judge of this door by its outward appearance, we should think it was formed of a mass of earth coarsely worked, and covered internally by a solid web; which would appear sufficiently wonderful for an animal that seems to have no special organ for constructing it; but, if it is divided vertically, it will be found to be a much more complicated fabric than its outward aspect indicates, for it is formed of more than thirty layers of earth and web, emboxed, as it were, in each other, like a set of weights for small scales.

If these layers of web are examined, it will be seen that they all terminate in the hinge; so that the greater the volume of the door, the more powerful is the hinge. The frame in which the tube terminates above, and to which the door is adapted, is thick, and its thickness arises from the number of layers of which it consists, and which seem to correspond with those of the door; hence the formation of the door, the hinge and the frame seem to be a simultaneous operation, except that, in fabricating the first, the animal has to knead the earth, as well as to spin the layers of web. By this admirable arrangement, these parts always correspond with each other, and the strength of the hinge, and the thickness of the frame, will always be proportioned to the weight of the door.

The more carefully we study the arrangement of these parts, the more perfect does the work appear. If we examine the circular margin of the door, we shall find that it slopes inwards, so that it is not a transverse section of a cylinder, but of a cone; and, on the other side, that the frame slopes outward, so that the door exactly

applies to it. By this structure, when the door is closed, the tube is not distinguishable from the rest of the soil, and it is doubtless for the purpose of effecting this concealment that the door is formed with earth. Besides, by this structure, also, the animal can more readily open and shut the door. By its conical shape, it is much lighter than it would have been if cylindrical, and so more easily opened; and, by its external inequalities, and mixture of web, the spider can more easily lay hold of it with its claws. Whether she enters her tube or goes out, the door will shut of itself. This was proved by experiment; for though resistance, more or less, was experienced when it was opened, when left to itself it always fell down, and closed the aperture. The advantage of this structure to the spider is evident; for whether it darts out upon its prey, or retreats from an enemy, it is not delayed by having to shut its door.

The principal instruments by which this little animal performs her various operations, are her mandibles and her spinners. The former, besides the two rows of tubercles, between which, when unemployed, her claw or sting is folded, has, at the apex, or their inner side, a number of strong spines. As no one has ever seen her at work upon her habitation, it cannot be known exactly how these organs are employed in her various manipulations; but she probably makes use of her anterior legs along with them.

Though the particulars I have here stated, of the history and habits of these subterranean spiders, demonstrate, in every respect, as far as we know them, the adaptation of means to an end, far above the intelligence of the animal that exhibits them; yet, fully to appreciate the wisdom, power, and goodness that created her, and instigated her to exercise these various arts, and to employ her power of spinning webs in building the structures necessary for her security, as well as for the capture of her prey, we ought to be witnesses to all her proceedings, which would probably instruct us more

fully why she forms so deep a tube, and one so nicely covered with a peculiar tapestry from the mouth to the bottom.

SIXTH WEEK—SATURDAY.

SPIDER'S WEB.

THE power which the various races of spiders possess of spinning webs to entrap their prey is well known; but there are some curious particulars connected with this subject which, though not so generally understood, are exceedingly interesting.

This little animal is a devourer of flies and other insects, and seems to be intended by the Creator to fulfil the important part of preserving the balance in that department of the animal creation with which it is connected, by keeping in check the tendency to multiply to an inconvenient degree. In all the orders of living beings such a provision is made, from the lion and hyena which roam the forest, spreading carnage and desolation around, to the invisible tyrant of the infusory tribes, which the solar microscope has disclosed, called, on account of its insatiable voracity, the water-tiger. To accomplish this useful object, the spider is endowed with peculiar properties as well as instincts, the most remarkable of which is that of preparing and spreading nets to ensnare her prey.

The manner in which the material is formed for the fabrication of her net is as follows:—Immediately below the *anus*, planted in a roundish depressed space, are six jointed teat-like organs. Four of these are pierced with a multitude of holes, so numerous, and so extremely fine, that there are, in some species, above a thousand in each of the divisions, a space itself not bigger than the head of a pin. From every one of the holes a thread proceeds, so that the very finest part of the web, which we can scarcely see, is not a single thread, but a cord,

composed of no fewer than *four thousand strands*, to use the technical language of the rope-maker. The line spun by the smallest spider, itself no bigger than a grain of sand, is so fine, that *four millions* of them put together would not exceed the thickness of a human hair; so that the number of strands which would be necessary to form a line of this thickness, would not be less than *sixteen thousand millions*. This is not more startling to a person unaccustomed to such investigations than it is true.

There is an obvious intention in the extreme minuteness of the original strands. Not only is the viscous matter, of which the web is composed, by being exposed to the air in these exceedingly fine filaments, instantly dried, which seems necessary to its tenacity, but the line takes firmer hold, at the places where it is attached to some solid object, when its thousands of ends are pressed upon it, than if this were done with a single end; and what seems to be the chief intention, the line is much stronger in proportion to its thickness, by being formed of so many separate threads.

There are various ways in which the spider applies to her own use the threads she spins, some of them exceedingly artificial. One species employs them to enable them to mount into the air, another to cross streams, and another still, as we have seen, to form themselves a comfortable home; but the principal use to which this curious art is applied, is for the capture of their prey. There is great variety in the manner in which the snares are constructed. That of the *geometrician* is the most beautiful and symmetrical, being formed of lines diverging from a common centre, and crossed at minute intervals by other lines, drawn in spiral circumvolutions. This spider frequents shrubs and hedges, where she spreads her net. The house-spider, on the other hand, weaves her web like a piece of gauze or fine muslin, with threads attached to the edges of the web, joining and crossing in various directions, and carried up often to the height of several feet. These lines inter-

cept the insects flying across them, by which they become entangled, and, in struggling to get free, generally fall into the bosom of the net spread beneath to receive them. That she may keep quite out of sight, and not frighten away her victims, the spider often adds a little silken apartment below, or at one side of the web; and in order to know when any one is caught, she spins several threads from the edge of the net to that of her hole. These, by moving, give notice of what has happened, and serve as a bridge, by which she may run in a moment to any quarter where her prey is entangled.

Among all the remarkable instincts of this tribe, there is perhaps none so extraordinary as that of the species which build their nests under water. This creature is called the water-spider. She spins some loose threads, which she fastens to the leaves of water plants growing in a still pool. Among these threads she weaves for herself a cocoon, rendered impervious to water by covering the whole over with the gummy substance contained in her body. This apartment is about half the size of a pigeon's egg, and is formed with an opening below Having covered her own body partly over with this gum, thus, in some mysterious manner, forming for herself an air bag, she comes to the surface of the water, and draws in as much air as the bag will hold, which she conveys to her cell. This operation she repeats many times, till the cell is filled and expanded with air, the water being expelled; and during the operation, she usually swims upon her back, the air-bag, which is fixed to her abdomen, appearing like a bubble of quicksilver. In this diving-bell the spider lives, keeping herself quite dry, and having sufficient means of respiration, although under water. Here, too, she carries the prey which she captures, diving below the water, and entering her habitation by the aperture underneath.

The whole operations of these insects are exceedingly curious, and there is yet one other circumstance which I have to mention: They are gifted with the faculty of

walking, in opposition to gravity, even upon glass, with their bodies inverted. According to the observations of Mr Blackwall, this is not effected by producing atmospheric pressure by the adhesion of suckers, as is the case with flies, and some other creatures, but by a brush, formed of "slender bristles, fringed on each side with exceedingly fine hairs, gradually diminishing in length as they approach its extremity, where they occur in such profusion as to form a thick brush on its superior surface."* These brushes he first discovered on a living specimen of the largest species of this insect, called the bird-spider; and the same structure, as far as his researches were carried, he found in those species which can walk in counteraction of gravity upon glass. Solomon mentions the spider among "the things that are little upon the earth, yet exceeding wise;" and one proof which he gives of her wisdom is, that "she taketh hold with her hands." There is, indeed, consummate wisdom in the contrivance by which she is enabled to do this, although we may not be able to understand how a brush so contrived as Mr Blackwall describes, can bestow upon her that power to the extent in which she possesses it.

But the instruments with which the spider constructs her web, rather than those which she employs in locomotion, were probably the objects of Solomon's admiration. These I shall not stop to describe, as they would lead us too much into detail. I shall only observe, that they are among the most remarkable parts of her structure, containing, as they do, regularly formed carding and spinning machines, which the animal employs for extracting the matter from the teat-like organs, already described, and drawing or weaving them into threads or webs at her pleasure. Entomologists have felt it an agreeable task to dwell on the peculiarities of this class of beings; and they form a theme no less pleasing to those who delight to trace the Creator in his works.

* Linnean Transactions.

SEVENTH WEEK—SUNDAY.

SPIRITUAL TRANSFORMATION.

The changes we have been considering are peculiar and strange; and, in contemplating them, we are apt to forget that this class of transformations forms only a particular modification of a law that is universal among organized existences. The change of a seed into a plant; its development till it produces leaves, and flowers, and new seeds; its decay and resolution into its original elements; and the combination of these elements, again, into new forms of vegetable or animal life,—all these are as truly transformations, and, in their kind, as wonderful and admirable, as that of the insect egg into a worm, the worm into a chrysalis, and the chrysalis into a fly. Among animals the changes are still more striking. The embryo in the womb, and the egg which the mother hatches, have already undergone an astonishing transformation, and are destined to undergo other alterations of so extraordinary a nature, that they may well be compared to a metamorphosis. Being destined, in their earliest stage, to exist in a fluid, they are then possessed of organs, resembling the gills and corresponding organs of a fish, which disappear as the lungs are developed, and as the animal becomes fitted for breathing the vital air. Birth is a transformation as complete as the escape of an insect from its pupa-case. The creature appears in a new element, and has acquired new faculties adapted to its altered condition. As it grows, new developments take place, and corresponding powers and instincts are implanted; till at last the system decays, the powers of life give way; it dies, and returns to its kindred dust. Nor is this the last change in one class of beings. The lower animals may, like plants, be destined to give forth the particles of which their bodies are composed, in con-

tributing to the subsistence of other organized beings; and this, to a certain extent at least, is also true of man. But, besides this, the descendant of Adam has a peculiar privilege belonging to him, as a rational creature redeemed from death, and destined for immortality. There is an indestructible germ in his earthly part, and from this shall spring forth a celestial body; for "the dead shall hear the voice of the Son of God, and they that hear shall live."—It is the last and greatest transformation of his material frame.

But, corresponding to these bodily metamorphoses, there is also a transformation of the mental powers, which takes place in those who are the objects of heavenly influences; nor is this without its analogy in the inferior creatures. Bodily transformations are always attended with some remarkable changes in the habits and functions of the animals which are subjected to them. The chick in the egg is quite a different being from the fowl, not merely in its corporeal frame, but in its capacities and its instincts; and, in the same manner, the change wrought in the redeemed at the resurrection, will doubtless be of amazing extent, comprising all the powers and faculties of the soul.

Before this final transformation, there is one of a nature scarcely less surprising, though more imperceptible, and generally more gradual, that passes upon those who, while they remain in the regions of time, are undergoing that process, which is finally to fit them for eternity; and who cease to be conformed to this world, being "transformed by the renewing of their minds."

The necessity of this change depends on a fact in the human constitution, undeniable in itself, yet so strange and unaccountable to all who reject the Gospel, that many ingenious attempts have been made to explain it away. I need scarcely observe, that I allude to the natural depravity of the human heart. Moral philosophers have exercised their talents in describing what constitutes the perfection of the human character; and they

have drawn many beautiful and fascinating pictures of the mind of man, in the full development of its moral faculties. These are pictures, however, which, throughout the thousands of ages that have rolled away since man was called into existence, have never been realized, except in one individual, and *He more* than man. Why is this? Assuredly there are not wanting motives, strong, pressing, and paramount, to induce human beings to adorn their lives with those virtues and graces, which form the perfection of mankind, and which contribute so essentially to promote their happiness. Above all, these motives come home with tenfold weight to the heart of the professing Christian, who views this character embodied so beautifully in the life of Jesus. Yet he too remains, for the most part, unaffected by the very incentives, the force and importance of which he freely acknowledges; and when, at last, he feels them moving his heart, and influencing his conduct, he is forced to confess, that the change was not wrought by his own unaided exertions; that it was always superinduced on a powerless, and frequently rebellious, nature. For many revolving years, perhaps, a thousand impressive appeals had been made to his sense of duty, interest, and gratitude; but in vain. In vain had he been exhorted to obey his Creator and Redeemer; in vain had he been warned to flee from the wrath to come, and reminded of the glory, honour, and immortality which await believers in the world of spirits. These appeals perhaps roused him for a moment; but he fell again into his deep sleep, or he only remained awake to drown his convictions, by drinking the intoxicating cup of the world to the very dregs.

Neither has the warning voice of Providence power to gain admittance to the heart in its natural state. In what expressive language does God speak to our souls, in the events that are passing around us? How solemnly —how pathetically—does he warn us, that our treasure is not on earth. How painfully are we reminded that

human strength is but a shadow,—that pleasure is but a dream,—that life itself is but "a vapour which appeareth for a little time and then passeth away." We see our hopes blasted, our enjoyments fading, our friends one by one perishing around us:—We shed a tear, we breathe a sigh, we say all is vanity, and then we return with greediness to those very pursuits of which we have beheld the emptiness and the termination.

But there are others, on whom these appeals and warnings have a very different effect. At one period of their lives, perhaps, they were as callous and unmoved as those whose case we have been considering. But the vail has been removed from their hearts, and they wonder at the weakness and perverseness of their former selves, and are sensible that "there is no profit in those things of which they are ashamed." They now realize to their souls the truths of the Gospel, and a new light is thrown on every thing they behold. To their unveiled eye,—heaven opens in its glory above them, and hell yawns in its horror beneath. The love of God is shed abroad on their hearts; gratitude to their Redeemer glows in every feeling of their soul; they hear the warning voice of Providence in every event of their lives. When they sorrow, it is not "as others, who have no hope;" when they rejoice, it is a foretaste of the joy of angels. And their conduct corresponds with their feelings: They adorn the doctrine of their Lord and Saviour, by lives becoming the Gospel.

Whence is this difference,—so entire, so universal, so astonishing? How comes it that human beings should be so opposite to each other in their feelings, in their desires, in their affections,—in the whole tenor of their lives? Nay, how comes it that the very same individual should, at different periods of his life, be so opposite to his former self? Is it by his own efforts that a man is renewed in the spirit of his mind? If so, in what corner of the unregenerate heart does the power lie dormant? Why did he remain so long,—why do many re-

main to the end of their lives,—unaroused by the warnings of Providence however awful, and by the truths of the Gospel however earnestly urged?

Can reason answer this mysterious question? It will scarcely be alleged. But the declaration of Scripture is express. We are naturally, it tells us, in a state of spiritual stupor; and, just as the chrysalis, when it bursts its shell, passes from partial insensibility to the consciousness of a new and better existence, expanding its painted wings to the sun, and revelling in the varied delights which its Creator has provided for it, so it is with those human beings who have been brought from darkness and slavery into light and liberty. They have "put off the old man and put on the new,"—they are "born again,"—they have "become new creatures,"—they are "risen with Christ."

And how has this change been effected? By the Spirit of God. It is He who has moved on the soul, as erewhile He moved on the face of the formless void, bringing order out of confusion. He "creates us anew," expelling earthly affections, warming us with new life, animating us with new desires, and enabling us to expatiate in new and more glorious regions,—to rise from earth to heaven, to claim alliance with celestial spirits, and to cast the anchor of our hopes in eternity.

SEVENTH WEEK—MONDAY.

LEGIONARY AND SANGUINE ANTS.

I HAVE elsewhere noticed the care which the various species of ants take of their young, as well as the art with which some of them construct their habitations;* there are numerous other habits and instincts exhibited by different families of this very diversified class, which, however attractive, I cannot stop to examine. I shall

* "Spring," pp. 155, 156. Third Edition.

confine myself to one feature in the history of two different species, equally peculiar and interesting.

The Legionary or Amazon ants, are a species not hitherto found in Britain, whose trade is war, and whose subsistence depends on the success with which they invade and enslave ants of another class. The younger Huber has paid great attention to the warlike habits of this remarkable community, and the manner in which they procure labourers to provide for their domestic comforts; and the result of his investigations is so surprising, that were not his account confirmed by other naturalists of undoubted veracity and sound understanding, we might be inclined to believe that his imagination had affected the sobriety of his judgment. In abridging his narrative, I shall select those incidents which seem to be most illustrative of the peculiar instincts of this remarkable insect.

"On the 17th of June, 1804," observes this pleasing writer, and accurate observer, "whilst walking in the environs of Geneva, between four and five in the evening, I observed, close at my feet, traversing the road, a column of legionary ants. They moved with considerable rapidity, and occupied a space of from eight to ten inches in length, by three or four in breadth. They soon approached a nest inhabited by a colony of the negro ant, the dome of which rose above the grass. Some of the negroes were guarding the entrance; but, on the discovery of an approaching army, darted forth on the advancing legion. The alarm instantly spread into the interior, whence their companions rushed forth in multitudes to defend their homes. The legionaries, the bulk of whose army lay only at the distance of two paces, quickened their march, and, when they arrived at the hill, the whole battalion fell furiously upon the negroes, who, after an obstinate, though brief contest, fled to their subterranean galleries. The legionaries now ascended the dome, collected in crowds on the summit, and taking possession of the principal avenues, left some

of their companions to excavate other openings in the exterior walls. They soon effected this, and through the breach the remainder of the army made their entrance; but, in about three or four minutes afterwards issued forth again, each carrying forth a pupa or grub, with which booty they retraced their route, in a straggling or irregular march, very different from the close orderly array they had before exhibited."

Next day M. Huber witnessed successful attacks by this warlike tribe on two other negro hills in the same vicinity. He went to the encampment of the victors before their return, and was surprised to observe all around a great number of the very negro species which they had been attacking. "I raised up a portion of the building," he goes on to say, "and upon still perceiving more, I conjectured that it was one of the encampments which had already been pillaged by the legionaries; but I was set right by the arrival at the entrance, of the very army I had been watching, laden with the trophies of victory. Its return excited no alarm among the negro ants, who, so far from offering opposition to the entrance of the triumphant army, I even observed approaching the warriors to caress them, and present them with food, as is the custom among their own species; whilst the legionaries, in turn, consigned to them their prisoners, to be carried into the interior of the nest."*

The curiosity of our naturalist being thus awakened, he directed his attention to the subject, and witnessed various other marauding excursions of a similar kind, and for a similar purpose. He observed, in some instances, that the negro army, after repeated defeats, as if conscious of their weakness, barricaded the several entrances to their encampment, with the evident intention of standing a regular siege. The manœuvre, however, never succeeded. Their formidable and persevering enemies soon effected a breach with their mandibles and their feet, and overcame all opposition. "I was wit-

* Huber on Ants, p. 254.

ness," says Huber, "every day during summer to these invasions."

Sometimes the legionaries attack the more warlike communities of the mining ant, generally with a similar result, but with more of military art. Their phalanx is more compact in the advance, the onset is more furious, and they return after victory in more regular order.

Another species of ant, called the sanguine ant, on account of the blood-red colour of its head, thorax, and feet, is endowed with the same instinct as those whom Huber has denominated Legionary. These, however, differ in their mode of warfare. They do not send out numerous armies, or attempt to carry their point by a single impetuous onset, but wage the war in small predatory parties. Huber illustrates their mode of attack by a very interesting account of a regular battle between a marauding party of this kind, and a formidable encampment of the negro ants, in which a regular communication was kept up with the main body in the colony, and reinforcements were sent to the depredators, in proportion to the necessity of the case. On the other hand, the assailed, while they gave token of a vigorous resistance, looked to the safety of the young; and, in this respect, exhibited one of the most singular traits of insect prudence. "Even long before success was at all dubious, they brought up the pupæ from their chambers under ground, and heaped them up on the other side of the nest from that where the invading army was making its chief assault, in order that they might be more conveniently carried off should the battle be lost. Their young females also took shelter on the same side." The attack ended with the route of the negroes, who, in their retreat, seized each on a pupa, and conveyed it to a place of safety, while the victors entered their city, and plundered it of the remaining treasure.

One of the most remarkable circumstances respecting these expeditions is, that the only object of attack is to

obtain possession of the young while in the insensible state of pupæ. The plunderers never make prisoners of the old negroes. The consequence is, that the captives become domesticated, without difficulty, in their new habitation, and give forth all their instincts for the benefit of their new owners. "Developed in the enemy's encampment, they afterwards become household stewards and auxiliaries to the tribe with whom they are associated. Brought up in a strange nation, not only do they live socially with their captors, but bestow the greatest care on their larvæ and pupæ, their males and females, and even evince the same regard for themselves, transporting them from one part of the colony to another, going in search of provisions for them, building their habitation, forming, as occasion requires, new galleries, and fulfilling the duties of sentinels, by guarding the exterior of their common abode, apparently not once suspecting that they live with those very insects which kidnapped them in their helpless and unconscious infancy. While the negro ants are engaged in these laborious employments, their masters rest tranquilly at the bottom of their subterranean city till the hour fixed for their expedition arrives."

It is very remarkable, that the warrior ants seem incapable of either building a habitation for themselves, or even of procuring their food,—offices which are always performed by their slaves, on whom, therefore, they appear to depend, not only for a house and home, but even for existence; and so faithful are those devoted negroes, that they seem cheerfully to perform every office which can contribute to the comfort of their masters. Huber endeavoured to ascertain whether or not the warrior ants could subsist without the aid of their slaves; and, with that view, enclosed thirty of them, and some undeveloped young of both races, in a glass-box with earth and a little honey. They were totally unable to use any exertion for their own comfort and support. Their food remained untouched, and in two days one-half of them

died of hunger. "I commiserated their condition," says the naturalist, "and gave them one of their negro servants. This individual, alone and unassisted, established order, formed a chamber in the earth, gathered together the larvæ, extricated several young ants that were ready to quit the condition of pupæ; and, in a word, preserved the life of the remaining legionaries."

Singular as this arrangement of Providence is, it is scarcely more so than that by which another species of ant has been taught to employ an entirely different race of insects as their domestic animals,—in the same manner as we do the cow,—feeding and protecting them, that they may extract from the bodies of these subject creatures a nourishing liquor for food. While we experience surprise, and even perhaps some degree of revulsion of feeling, at the existence of a regular system of slavery among these insects,—a practice which we so justly condemn, as it exists among human beings,—it must be remembered, as Kirby and Spence most truly remark, that there is a wide difference in the two cases, since the subjection of these creatures does not, like human slavery, prove a source of misery; for their situation is little, if at all, different from what it would have been, had they never been carried from their native colony. They are altogether unconscious of degradation,—indeed, in some respects, they act as masters,—and they pursue their instincts, and exercise their faculties, as freely, and with as much enjoyment, as they would otherwise have done. Looking back, indeed, to the origin of this condition, we find rapine and spoliation on the part of the invaders,—privation, injury, and distress on the part of the invaded; but this is nothing more than a new mode in which the evil inherent in a fallen world is exhibited; and that evil is, not only in the way already mentioned, but by various other means, tempered and alleviated, if not compensated. How curious it is to observe, throughout universal Nature, as it exists in this sublunary state, the same chequered scene of good and evil, enjoyment and

suffering! This condition comes more strikingly home to the mind, when, as, in the present instance, we see the virtues and vices of human beings, as well as their joys and sorrows, imitated and acted over again, as it were, by inferior and irrational creatures.

SEVENTH WEEK—TUESDAY.

THE LION ANT.

Of all the animals, evidently framed for the purpose of keeping the insect world in check by its predaceous habits, there is none so remarkable or so formidable as the lion-ant,—an insect which bears no alliance, except in some resemblance of form, to that more interesting creature whose name it bears. The following description is chiefly given in the lively language of Goldsmith:—

The lion-ant is of the size of a common wood-louse, but somewhat broader. It has a pretty long head, and a roundish body, which becomes a little narrower towards the tail. The colour is a dirty grey, speckled with black, and the body is composed of several flat rings, which slip one upon another. It has six feet, four of which are fixed to the breast, and two to the neck. The head is small and flat, and in front there are two little smooth horns or feelers, which are hard, about a quarter of an inch long, and crooked at the ends. At the basis of the feelers there are two small black lively eyes, with which it can see very acutely, as is easily discovered by its starting from every thing that approaches.

To form a so unpromising, and apparently so ill provided for the purposes of rapacity, this animal unites one of the most ravenous appetites in nature: yet it has neither wings nor feet to enable it to advance on its prey. Legs, indeed, it has; but these only enable it to run backward; and it might die before it could make

the smallest progressive motion. Thus, rapacious as it is, its prey must come to it, or it must starve.

But Nature, that has denied it strength or swiftness, has given it an equivalent in cunning, so that no animal fares more sumptuously, without ever stirring from its retreat. For this purpose it chooses a dry sandy place at the foot of a wall, or under some shelter, in order to preserve its machinations from the rain; or, rather, I should say, that this appropriate station is chosen for it by Him who bestowed the instinct on the parent fly. The driest and most sandy spot is the most proper for it; because a heavy clogged earth would defeat its object. When it goes about to dig the hole where it takes its prey, it begins by bending the hinder part of its body, which is pointed, and thus works backward, making, after several attempts, a circular furrow, which serves to mark out the size of the hole it intends to form. Within the first burrow it digs a second, then a third, and afterwards others. Then it begins to deepen its hole, sinking lower and lower into the sand, which it throws with its horns and feelers towards the edges, as we see men throw up sand in a sand-pit. Thus, by repeating its labours all round, the sand is thrown up in a circle about the edge of the pit, until the hole is quite completed. The outer edge is always formed in a perfect circle, and the pit itself resembles the inside of an inverted funnel,—generally, for a full-grown insect, about two inches deep, and as much in diameter. When the animal meets with obstacles, it is most ingenious and assiduous in removing them. M. Bonnet mentions, that when a stone interrupts its labours, which it cannot remove like the sand by jerking it out, it crawls backwards, and thrusting its tail under it, is at great pains to get it balanced on its back, by an alternate motion of the rings composing its body. When it has succeeded in adjusting the stone, it crawls up the side of the pit with great care, and deposits its burden on the outside of the circle; but this is a work of great nicety, and the poor

animal is frequently doomed to endure the torment of Sysiphus; but it is endowed with wonderful perseverance, and will not abandon its work, and commence a new pit, till after many unsuccessful attempts.

The work being thus, with great labour, finished, the insidious insect places itself in ambush, hiding itself in the bottom under the sand, in such a manner that its two horns encircle the bottom of the pit. All the sides of this pit-fall are made of the most loose and crumbling materials, so that scarce any insect can climb up that has once got down to the bottom. Apparently conscious of this, the lion-ant remains in patient expectation, ready to profit by that accident which throws some heedless little animal into its den. If, by misfortune, an ant, a wood-louse, or a small caterpillar, walks too near the edge of the precipice, the sand gives way beneath its feet, and it falls to the bottom of the pit, where inevitable destruction awaits it. The fall of a single grain of sand gives the assassin notice at the bottom of its cave, and it never fails to make an effort to seize upon its prey; should the destined victim prove too nimble, and get beyond reach of its claws, the lion-ant has another contrivance, still more wonderful than the former, for, by means of its broad head and feelers, it has a method of throwing up a shower of sand, which falls upon the little struggler, and once more crushes it down to the bottom. When the insect is once fallen thus low, no efforts can release it; its enemy seizes it with its hollow feelers, and darting them both into its body, sucks out all the hapless animal's juices with the utmost greediness.

When the prey is thus reduced to a husk, and nothing but the external form remains, the next care of the murderer is to remove the body from the cell. It takes up the wasted carcase with its feelers, and throws it, with wonderful strength, at least six inches from the edge of its hole, and then patiently sets about repairing the breaches which its fortifications had received in the

last encounter. Nothing can abate its industry, its vigilance, its patience, or its rapacity. It will work for a week together to make its pit-fall; it will continue on the watch for more than a month, patiently expecting the approach of its prey; and if it comes in greater quantities than is needful, still the little voracious creature will quit the insect it has newly killed, and leave it half eaten, to attack another and another which falls within its reach. Although so voracious, the lion-ant is remarkably patient of hunger; some of the species having been kept in a box with sand, for six months and upwards, without feeding at all.

When the lion-ant has attained a certain age, and the time of its change approaches, it burrows deeper in the sand, where it spins itself a cocoon. This cocoon is about half an inch in diameter; the outside is composed of sand and silk, the inside is lined with silk only, of a fine pearl colour, extremely delicate and beautiful. There it passes through its chrysalis state, like most other insects, and at last comes forth a beautiful fly, of the libellula or dragon-fly species, with a long slender body, of a brown colour, a small head, large bright eyes, long slender legs, and four large transparent reticulated wings. The remarkable expansion of its body and wings, in comparison with its former size, which so suddenly takes place after leaving its pupa-case, has already been noticed.

This insect, in its perfect state, holds the same place in the economy of nature as it did before. It serves as a check on the various tribes of flies, as it formerly did on those of the caterpillar family, and the other little creepers of its own class. It is the strongest and the most courageous of all winged insects; nor is there one of this genus, how large so ever, that it will not attack and devour. The blue-fly, the bee, the wasp, and the hornet, make its constant prey, and even the butterfly, that spreads so large a wing, is often caught and treated without mercy. Its appetite seems to know no bounds;

it spends the whole day in the pursuit, and has been seen to destroy three times its own size in the capture of a single hour. With its six claws it seizes its prey on the wing, which it tears easily to pieces with its powerful teeth. In all these habits this insect resembles its congeners of the same species, though various kinds of the dragon-fly have a very different origin, being, in their early stages, inhabitants of the water.

SEVENTH WEEK—WEDNESDAY.

THE QUEEN-BEE.

Bees have already been noticed both in the "Winter" and "Spring" volumes,—in the former to describe their hybernating, and in the latter their reproductive, instincts. But there is scarcely any thing in which these interesting little creatures do not strikingly exemplify the wisdom and the tender care of their Creator; and this paper shall be devoted to the consideration of some of their remaining instincts.

The mode of production of the queen-bee, its habits, and its relation to the rest of the hive, are circumstances which have not yet occupied our attention. In all these there is something exceedingly peculiar. Many gregarious animals, indeed, have leaders; and there are some insects, such as ants, which, like bees, have a queen, the mother of the whole progeny. There are none, however, so far as has yet been ascertained, which can at all be compared, in their properties and functions, with the little insect just mentioned.

The queen-bee, although she can bear no rival near her throne, yet carefully deposits the eggs which are to form new queens in the royal cells prepared for their reception. It is believed that there is no original difference between the egg of a queen and that of a worker,—that all working bees are females, but that they remain un-

productive unless the larva be nursed in a particularly constructed cradle, and fed with a peculiar food. It is certain, at least, that a royal cell is different from all others, and that there is something peculiar in the food administered to the young queens in their infant state, as well as in their general mode of management; and it is not less certain, that the bees have it in their power to convert, at pleasure, the larva of a working-bee into a queen.

The following is the account given in the Edinburgh Encyclopedia, of the manner in which the remarkable conversion I have mentioned is effected:—"Immediately on the loss or removal of a queen, the whole hive is a scene of tumult and disorder;* the bees seem to anticipate their own destruction, by the precautions they take to guard against it. Should there be neither eggs nor broods in the combs, they will infallibly perish; their instinctive faculties are lost; they have no object for which their labours are united; they cease to collect honey or prepare wax, and in a short time they disappear and die.

"But if there be brood in the combs, the industry of the bees continues unabated; for by the proceeding that they follow, they know that their loss will be repaired.

* This is not quite correct. Mr Roget gives the following graphic account of what takes place in a hive on such occasions. "When the queen bee is forcibly taken away from the hive, the bees which are near her at the time, do not soon appear sensible of her absence, and the labours of the hive are carried on as usual. It is seldom before the lapse of an hour, that the working bees begin to manifest any symptoms of uneasiness, they are then observed to quit the larvæ which they had been feeding, and to run about in great agitation, to and fro, near the cell which the queen had occupied before her abduction. They then move over a wider circle, and on meeting with such of their companions as are not aware of the disaster, communicate the intelligence by crossing their antennæ, and striking lightly on them. The bees which receive the new become in their turn agitated, and conveying this feeling wherever they go, the alarm is soon participated by all the inhabitants of the hive. All rush forward with tumultuous precipitation, eagerly seeking their lost queen; but after continuing the search for some hours, and finding it to be fruitless, they appear resigned to their misfortune; the noise at length subside, and the bees quietly resume their labours." —*Bridgewater Treatise*, vol. ii. pp. 287, 288.

Having selected a worm three days old or less, they sacrifice three of the contiguous cells, that the cell of the worm may be formed into one adapted to breed a queen. They next supply it with the necessary food; which is not the common farina, pollen, or bee-bread, on which the young of workers feed, but a peculiar kind of paste or jelly, of a pungent taste, which is reserved for the queen alone. A cylindrical enclosure is raised around the worm, whereby its cell becomes a perfect tube, with its original rhomboidal bottom; for that part remains untouched. Were it injured, the fabric of the other three cells on the opposite side of the comb would be deranged, which would be a needless waste. The cell is still horizontal, like the rest of the combs, and thus remains during the first three days of the existence of the worm; but the bees, in prosecuting the enlargement, alter its direction, and form it to hang perpendicularly, as all those cells do which have been inhabited by queens. In performing this essential part of the operation, they do not scruple to destroy the worms surrounding the tube, and use the wax of their cells in constructing the new part, which they apply at right angles to the first, working downwards. The cell is then of a pyramidal figure, usually near the edges of the combs. It insensibly decreases from the base, and is closed at the top, when the included worm is ready to undergo its transformation to a nymph. When reaching maturity, the seal is broken, and a queen comes forth qualified to fulfil every indispensable function on which the preservation of so many thousand lives depends. Working bees have, therefore, the power of effecting the metamorphosis of one of their own species, to avert the effects of a loss, which would prove the utter ruin of the whole colony."*

Nothing can easily be conceived more curious than the change which is thus effected. That by a certain mode of management which instinct points out, an insect

* Edinburgh Encyclopedia—article Bee, p 407.

should be so changed in its form, in its functions, and in its habits, is beyond measure surprising. When we think of the extent of the change, we shall find nothing in nature analogous to it. The same animal, which, had its growth and training proceeded in the usual way, would have been one individual among many thousands secreting wax, building cells, flying abroad on busy wing to collect honey or pollen, or remaining at home to dress the comb and nurse the young, is deprived of all these powers and instincts, and in their place acquires a new nature, which renders her an absolute monarch, whom the thousands that would otherwise have been her equals revere and obey; which confines her, except on one or two peculiar and pressing occasions, to the precincts of her little kingdom; which makes her the mother of the succeeding generation and of new communities; which elevates her, in short, to be the presiding genius on whom the prosperity and the very existence of the whole commonwealth depend. All this is a mystery, into the physiology of which the naturalist shall in vain attempt to penetrate. But its *final cause* is clear and indisputable. The destinies of the whole depend on the life of their queen. The Creator, who willed this, foresaw and provided against the consequences which would ensue were there no means of repairing the loss of this precious life. The contrivance, however mysterious, is admirable and efficient,—worthy of the Divine wisdom and benevolence, from which it proceeds.

Swarming is another subject of great interest, with regard to the causes of which much remains unexplained. It has been ascertained by Huber, that the first swarm is uniformly led out by the old queen, at a time when she has stocked the hive with numerous eggs, and especially when there are several young queens approaching maturity. All the subsequent swarms are led out by young queens. One chief phenomenon which precedes swarming, consists in the agitation of the queen. She is suddenly affected from some unknown cause, it

may be from a consciousness which she has acquired by sounds emitted from the royal cells, or otherwise, of the approaching period of the production of rivals. She hastily traverses the combs, abandoning that slow and dignified progress which she usually maintains; her agitation is communicated to the bees; they crowd to the outlets of the hive; and the queen escaping first, they hasten in great numbers to follow her. She generally takes but a short flight, and wherever she settles, she is surrounded by her faithful and devoted subjects.

This is the process.—And here again, although the physical cause is obscure, the Creative intention is obvious.—A queen is said to lay from 50,000 to 100,000 eggs in a single season, all of which may produce living bees. No ordinary hive, or, in their wild state, no hollow of a decaying tree, in which they usually fix their habitation, is sufficient to contain such numbers with advantage. They must separate therefore into distinct communities; and that this may be effected in proper times, and under advantageous circumstances, this peculiar instinct is bestowed.

There are many other instincts and functions belonging to this interesting creature, besides those already mentioned, which it would be pleasing to enumerate, such as the nature of the means by which they communicate information; the remarkable power of stilling and confounding the hive, which is possessed by the queen in the emission of certain sounds; the qualities of wax and of honey; the precautions adopted by bees to obviate danger; the instinctive antipathies and affections both of the queen and her subjects. On these, however, I must not at present enlarge. Books have been written on the subject, and have not exhausted it; and I shall only add, that the whole history is impressed with traces of a Divine hand.

SEVENTH WEEK—THURSDAY.

VERTEBRATED ANIMALS.—THEIR PHYSIOLOGICAL CHARACTER.

The classes of living beings which I have hitherto been considering, are those belonging to the lowest species of existences, which possess no strong internal framework on which the living fibre may be sustained, but, when strength is required, are fitted by their intelligent Creator with external apparatus for that purpose. Higher orders, however, were destined to inhabit this terraqueous globe, whose habits and functions seem to be incompatible with this mode of construction, and hence a complete and radical change of the animal organization was resorted to, and the great division of vertebrated animals took its origin.

The observations of Dr Roget on this subject are so sensible and so appropriate, that I am sure I cannot do any thing more acceptable than to use his words. If it be pleasing, says this philosopher, to trace the footsteps of Nature in constructions so infinitely varied as those of the lower animals, and to follow the gradations of ascent from the zoophyte to the winged insect, which exhibits the greatest perfection compatible with the restricted dimensions of that class of beings, still more interesting must be the study of those more elaborate efforts of Creative power, which are displayed on a wider field in the higher orders of the animal kingdom. In the various tribes of beings which are now to come before us, we find Nature proceeding to display more refined developments in her system of organization; resorting to new models of structure, on a scale of greater magnitude than before; devising new plans of economy, calculated for more extended periods of duration; and adopting new arrangements of organs, fitted for the exercise of a higher order of faculties. The result of these more elaborate constructions is seen in the vast series of

vertebrated animals, which comprises a well-marked division of zoology, comprehending all the larger species that exist on the globe, in whatever climate or element they may be found, and including man himself, placed, as he unquestionably is, at the summit of the scale;—the undisputed lord of the Creation.

A remarkable affinity of structure prevails throughout the whole of this extensive assemblage of beings. Whatever may be the size or the external form of these animals, whatever the activity or sluggishness of their movements, whether they be inhabitants of the land, the waters, or the air, a striking similitude may be traced both in the disposition of their vital organs, and in the construction of the solid framework, or skeleton, which sustains and protects their fabric. The quadruped, the bird, the tortoise, the serpent, and the fish, however they may differ in subordinate details of organization, are yet constructed on one uniform principle, and appear like varied copies from the same original model. In no instance do they present structures which are altogether isolated, or can be regarded as the results of separate and independent formations.

In proceeding from the contemplation of the structures of articulated to those of vertebrated animals, we appear to pass, by a rapid excursive flight, from one great continent to another, separated by an immense gulf, containing no intermediate islands from which we might gather indications of those tracks of land having been originally connected. At the very first sight, indeed, the general fabrics of these two descriptions of animals appear to have been constructed on opposite principles; for, in the articulated, as we have already seen, the softer parts are internal, and are enclosed in a solid crust, or shell, or horny covering, answering at once the purposes of protection and mechanical support, and furnishing extensive surfaces for the attachment of the organs of motion. But in the *vertebrata*, the solid frame-work which serves these purposes, occupies, for the most part,

an internal situation, constituting a true-jointed skeleton, which is surrounded by the softer organs, and to which the muscles, destined to move their several parts, are attached. The office of external defence is entrusted solely to the integuments, and their different appendages.

Such is the general character of the arrangements which Nature has here adopted; from which, however, she has occasionally deviated with respect to some important organs of extremely delicate texture, and which require to be shielded from the slightest pressure. This occurs with regard to the brain and the spinal marrow, which are specially guarded by a bony structure, enclosing them on every side, and forming an impenetrable case for their protection. The solid mass of bone thus provided to defend the brain, gives also the opportunity of lodging safely the delicate apparatus subservient to the finer senses, namely, those of sight, of hearing, and of smell. The security which these organs derive from this protection, allows of their being carried to a higher degree of improvement than could be attained in the lower orders.

There is also another advantage, of considerable moment, which results from the internal situation of the skeleton, namely, that it admits of an indefinite extension by growth, without interfering with the corresponding enlargement of the softer organs; for, in all the instances in which this arrangement is reversed, that is, whenever the enclosing surfaces become solid, and can no longer yield to the dilatation of the contained organs, no alternative remains but that of breaking up the exterior case, and wholly casting it off, to make room for the further growth of the animal; after which operation, it has to be replaced by another covering of larger dimensions. This operation is generally required to be performed a great number of times, before the animal can acquire the size it is destined to attain. Hence the perpetual moultings of the caterpillar; hence the repeat-

ed castings of the shells of the crustacea; and hence, also, the successive metamorphoses of the insect. Nothing of this kind takes place among the vertebrata, where all the organs are developed in regular and harmonious succession, without the slightest mutual interference, and without those vicissitudes of action and of torpidity, which we witness in the chequered existence of the insect.*

SEVENTH WEEK—FRIDAY.

REPTILES.—THE TORTOISE.

In passing from invertebrated to vertebrated animals, a great step, as we have seen, is taken in animated nature. The whole type of the physiological structure is changed, and new principles are introduced. There are, notwithstanding, various resemblances and identical organs, which manifest the same great Artificer. There are, in both classes, organs of sight, of hearing, of smell, and of taste; there is the sense of feeling diffused in both cases over the whole body; the living fibre in both is of a similar nature; the animal exists and grows in both instances by consuming and digesting food; and it has powers of locomotion by means of legs and wings, or in some species by means of movements or writhings in the body. In all these, and in very many other particulars, there is an obvious analogy, and besides this, there is, in various species, an approach in form and in habits, which seems to be intended as a connecting link between the two great departments of living beings.

In this higher order of animated nature, as well as in the lowest, there is an ascending scale, and as the simplest form of vertebrated animals is to be found in the waters, physiologists have agreed in introducing fishes

* Dr Roget's Bridgewater Treatise, vol. i. pp. 261-265.

into their systems, as the first and lowest class. It will, however, correspond better with my plan to proceed at present with the lower animals, belonging to the land; and, of these, I commence with a species of reptile, allied both to land and water, which differs from all other orders of vertebrated animals, and approaches in its form nearer than any other to animals very low in the scale of organization, while it retains the essential characters of its own natural division;—I allude to the order *chelonia*, which comprises all the tribes of tortoises and turtles. This order, instead of presenting a skeleton wholly internal, exhibits a conformation, in which the trunk of the body is enclosed on every side by a bony case, which leaves openings only for the head, the tail, and the fore and hinder extremities. Although this structure bears some resemblance to that of the echinus and the crustacea, yet the substance which forms the outward defence is a real osseous structure, developed in the same manner as other bones, subject to all the changes, and having all the properties of these structures. Security seems to have been the object of the Author of Nature in this mode of formation, and for its attainment a vaulted and impenetrable roof has been constructed, capable of resisting enormous pressures from without, and proof against any ordinary measures of assault.

It is curious to remark, that, in the accomplishment of this design, nature has been true to the type of vertebrated animals, even while that design rendered a new arrangement and an apparent anomaly necessary. On examination, we find that all the bones composing the skeleton in other vertebrated animals exist also in the tortoise; and that the bony case which envelopes all the other parts, is really formed by an extension of the spinous processes of the vertebræ and ribs on the one side, and of the usual pieces which compose the sternum on the other. "It is scarcely possible," says Dr Roget, "to have stronger proofs, if such were wanting, of the

unity of plan which has regulated the formation of all animal structures, than those afforded by the skeleton of the tortoise."*

The tortoise class has been divided into four great families, one inhabiting salt water, two others fresh water, and a fourth living entirely upon the land. In all of them the same intention is manifested, that of protecting an inert animal from the attacks of its numerous foes.

This order, like that of the saurians, afterwards mentioned, is of very ancient date, and is to be found connected with the secondary series of geological formation, and existing along with the saurians, in every successive period of deposit down to the present day. The habits and functions of these early animals appear to have been similar to those of the existing species; and they are found in localities which prove, that, like them, different kinds lived respectively in the sea, in rivers, and on dry land. In general, these fossil species have been of larger dimensions than those which exist at present; and Cuvier mentions a sea-turtle, found at Luneville, the shell of which was eight feet long.† The impressions of footsteps made on the sand-stone of Corncockle Muir, which Dr Buckland has discovered to be those of a land-tortoise, are a proof of the existence of a species at that period, exceeding in size that of the corresponding species of the present day.‡

* Bridgewater Treatise, vol. i. p. 465.

† Oss. Foss. vol. v. part 2. p. 525.

‡ In the observations on geology contained in the "Winter" volume, I quoted some observations of Dr Buckland on the footmarks of the land-tortoise in the quarry of Corncockle Muir. I may take this opportunity of adding, that the footmarks are not entirely confined to that locality, having been found in various other quarries in that neighbourhood, and in the quarry of Craigs, in the immediate neighbourhood of Dumfries. In regard to the latter fact, the following notices may interest the geologist:—The Craigs Quarry, where these additional footmarks occur, is situated about two miles to the east of Dumfries, and is at the distance of between nine and ten miles south from the quarry of Corncockle Muir, from which it is separated by a chain of hills of transition rock, running from east to west, and dividing the basin of the Annan from the valley of the Nith. The sandstone on which the footmarks are found dips, like almost all the sandstone in the neighbour-

There are some differences between the sea and land-tortoises, distinctly marking intelligence in suiting each to its own destined locality, which I do not stop to particularize. With respect to their mode of living, Goldsmith thus discriminates them:—"The land-tortoise lives in holes dug in the mountains, or near marshy lakes; the sea-turtle in cavities of rocks, and extensive pastures at the bottom of the sea. The tortoise makes use of its feet to walk with and burrow in the ground; the turtle chiefly uses its feet in swimming, or creeping at the bottom."

The tortoise is a harmless animal if left undisturbed. Secure in the pent-house of its shell, it can bid defiance to the attacks of other animals; and, living wholly on vegetable food, it has no predaceous habits to render it ferocious. It, therefore, never seeks the encounter; but its repose cannot be invaded with impunity. It is furnished with such a strength of jaw, that, though its mouth be destitute of teeth, and armed only with bony plates, wherever it fastens it infallibly keeps its hold, until it has taken out the piece. Even when the head is cut off, the jaws do not relax; and the muscles in death preserve a tenacious rigidity.

The following account is given by Goldsmith of the

hood, and especially like that of Corncockle Muir, in a westerly, or rather a south-westerly direction. A foot-track is now said to be in the quarry, but hid by rubbish, lying between sixty or seventy feet below the surface of the rock. The difference between the locality in which the present foot-marks are situated, and those of Corncockle Muir, may be thus shortly stated. In the latter, the quarry is situated at the top of a moderately elevated round-backed hill; in the former, it lies at the bottom of a ridge of the height of several hundred feet. In both, the impressions occur in *flagstone*, incumbent on which lie thick seams of solid rock; but in the Craigs Quarry there is this remarkable peculiarity, that while all the rest of the sandstone dips in the direction already mentioned, about an angle of 45 degrees, there is a stratum, or rather, I believe, a series of strata, of from fifteen to twenty feet in thickness, much coarser, and more friable, which is superinduced over the whole, lying nearly horizontal, and whose seams have no relation to those beneath, indicating a later and entirely independent deposit. What strata lie immediately above these horizontal layers I do not know, but towards the top of the ridge there are extensive rocks, if not continuous strata of coarse sandstone conglomerate.

astonishing vitality of this singular animal:—"Nothing can kill it; the depriving it of one of its members is but a slight injury; it will live though deprived of the brain; it will live though deprived of its head! Redi informs us, that, in making some experiments on vital motion, he, in the beginning of the month of November, took a land-tortoise, made a large opening in its skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this, the tortoise walked away without seeming to have received the smallest injury; only it shut the eyes, and never opened them afterwards. Soon after the hole in the skull was seen to close; and in three days there was a complete skin covering the wound. In this manner, the animal lived without a brain for six months, walking about unconcernedly, and using its limbs as before. But the Italian philosopher, not satisfied with this experiment, carried it still further; for he cut off the head, and the tortoise lived for twenty-three days after its separation from the body. The head also continued to rattle the jaws, like a pair of castonets, for above a quarter of an hour."

The vital energy of these creatures is not less remarkably displayed in their longevity, than in their surviving injuries, which would destroy any other vertebrated animal. Tortoises are well known to live more than eighty years; and Mr Murray, in his "Experimental Researches," records the following instances of protracted life:—In the library of Lambeth Palace is the shell of a land-tortoise, brought there about the year 1623, which lived to 1730, a period of 107 years. Another was placed in the Episcopal Garden of Fulham by Bishop Laud in 1625, which died in 1753, having survived 125 years. Another is mentioned as having lived 220 years; and one in Exeter Change 800 years! The latter account, however, is very problematical.

It is worthy of remark, that not only this species of

inferior vertebrated animals, but those to be subsequently noticed, namely, serpents, and the saurian reptiles, have a peculiar and analogous arrangement as to the circulation of their blood. Their blood does not, as anatomists express it, go through the great circulation. The creature has lungs, but the blood, instead of passing through them, as is the case with most warm-blooded animals, goes directly to the arteries, which send it through the frame. Hence it is able to live a considerable time without the necessity of breathing, though it would at last be stifled if put into a close vessel.

We have often, in the course of our investigations, had occasion to admire the varieties in the orders of organized existences, and the adaptations to peculiarities of habits and of locality, which they exhibit. Need I remind the reader of the new instances which the various reptile races exhibit of the same remarkable qualities; or is it necessary for me to draw the inferences as to the Divine perfections, and the inexhaustible resources of Creative skill which they display?

SEVENTH WEEK—SATURDAY.

REPTILES.—THE SERPENT.

The most simple of all the vertebrated animals, in its bodily organization, is the serpent, for which reason it is usually placed lowest in the scale of land animals belonging to this order.

"The serpent," says Goldsmith, "has from the beginning been the enemy of man, and it has hitherto continued to terrify and annoy him, notwithstanding all the arts that have been practised to destroy it; formidable in itself, it deters the invader from the pursuit; and from its figure capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus, possessed at once of potent

arms, and inaccessible or secure retreats, it baffles all the arts of man, though never so earnestly bent on its destruction."* It is probably owing to these gifts of its Creator, that even in the most civilized and best peopled countries, this poisonous and detested brood is still to be found spreading over the forests, and infesting the woodland path throughout almost every temperate and tropical region of the world.

The relative size of the serpent tribes is more various than that of any other class of animals, extending from a few inches in length to forty or even fifty feet. Probably the most formidable species has fallen and become extinct beneath the prowess of man, for early tradition abounds in details of the feats of heroes against serpents, which infested large districts with their fætor, and devastated whole provinces. There is, doubtless, exaggeration in these accounts, but this cannot be said of the historical fact, that while Regulus led his army along the banks of the river Bagrada, in Africa, an enormous serpent disputed his passage across. We are assured by Pliny, who says that he himself saw the skin, that it was a hundred and twenty feet long. It had destroyed many of the army, till at last the battering engines were brought out against it; and these assailing it at a distance, effected its destruction. Its spoils were carried to Rome, and lodged in the Capitol, and the general was decreed an ovation for the deed. In the present day, the Great Liboya of Surinam, which is said to be the largest species in existence, seldom exceeds thirty-six feet. Legaut, however, says he saw one in Java that was fifty feet long.

The skeleton of the serpent class exhibits the greatest possible state of simplicity to which a vertebrated animal can be reduced; for it consists merely of a lengthened spinal column, with a head but little developed, and a series of ribs. The vertebræ are very numerous, and are all united by ball-and-socket joints, which give

* Animated Nature, vol. iv. book iii. chap. i.

peculiar flexibility to the animal; and there are other admirable provisions, noticed by naturalists, in the ribs, and in the direction of the processes, to ensure that flexibility, and to admit of the body assuming every degree and variety of curvature.*

The marks by which this species is distinguished from the rest of the animated creation, are thus given by the author from whom I have previously quoted:—"They have the length and the suppleness of the eel, but want fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal, they have lungs to breathe with." Their most formidable weapon of offence is their poisonous teeth, which are thus described by Dr Roget. "The fangs of serpents are furnished, like the stings of nettles, with receptacles at their base for a poisonous liquor, which is squeezed out by the pressure of the tooth, at the moment it inflicts the wound, and conducted along a canal, opening near the extremity of the tooth. Each fang is lodged in a strong bony socket, and is, by the intervention of a connecting bone, pressed forward whenever the jaw is opened sufficiently wide, and the fang is thus made to assume an erect position."—"The tube through which the poison flows is formed by the folding in of the edges of a deep longitudinal groove, extending along the greater part of the tooth, an interval being left between these edges, both at the base and extremity of the fang, by which means there remain apertures at both ends for the passage of the fluid poison."†

This animal, although placed at the bottom of the scale of vertebrated existences, on account of the simplicity of its organization, is yet too artificially constructed to render it possible for the most careless observer to overlook the proofs which it affords of exquisite skill in the Creator. The intention of the Divine

* Roget's Bridgewater Treatise, vol. i. p. 45.
† Ibid. vol. ii. pp. 163, 164.

Mind in calling an animal into existence, at once so formidable and so malignant, for it is fierce and irritable, is a very different and more recondite question. Goldsmith says of serpents, that "nature seems to have placed them as sentinels, to deter mankind from spreading too widely, and from seeking new abodes, till they have cultivated those at home." Paley takes a more extended view of the subject, and after confessing the difficulty, which surrounds it, reasons as follows:—"From the confessed and felt imperfection of our knowledge, we ought to presume, that there may be consequences of this economy which are hidden from us. From the benevolence which pervades the general designs of nature, we ought also to presume, that these consequences, if they could enter into our calculation, would turn the balance on the favourable side. Both these I contend to be reasonable presumptions:—not reasonable presumptions, if these two cases were the only cases which nature presented to our observation;—but reasonable presumptions under the reflection, that the cases in question are combined with a multitude of intentions all proceeding from the same Author, and all, except these,* directed to ends of undisputed utility." Paley adds some considerations which, if they do not entirely vindicate the economy of Providence, at least greatly abate the difficulty attached to it. These are briefly, 1*st*, That the animal itself being regarded, the provision is *good*. It is a formidable means of defence from its enemies, and sometimes of subduing its prey. 2*d*, The poisonous bite is seldom fatal. 3*d*, While only a few species possess the venomous property, that property guards the whole tribe. There are only thirty-two tribes poisonous out of two hundred and eighteen described by Linnæus. 4*th*, The nature of serpents, as that of other existences, is appropriated to peculiar situations, which are, as it

* With the question of venomous bites, Paley combines that of animals preying upon each other. These, therefore, are also included in his exception.

were, their own; and, when man or other animals encroach on these, they do it at their peril."*

There is, doubtless, much in this reasoning; but it does not touch the main difficulty, which indeed Revelation alone can remove. I allude not merely to the existence of evil; but, in the present instance, to the elaborate preparation of instruments for the infliction of it, apparently beyond the necessity of the case. We can understand how this may be in a fallen world; and it is exceedingly remarkable that the only contrivance which cannot entirely be vindicated, as on the whole benevolent, that, I mean, whereby venom is infused into the bite, should be discovered to exist among a class of reptiles to which Revelation points as being the medium through which sin entered into the world, and all our woe. We may well believe, that when the curse fell on the serpent, by which it was made to "creep on its belly," it was at the same time invested with its poisonous fangs, as a memorial of the awful transaction to which it became accessory, and an instrument of that malignity, which was rendered thenceforth inherent in its nature.

* Nat. Theol. vol ii. chap. 26.

EIGHTH WEEK—SUNDAY.

"THE OLD SERPENT."

THE serpent, whose peculiarities of structure and habit we yesterday considered, was employed, soon after the creation of man, as an instrument in that awful transaction, by which "sin entered into the world, and death by sin."

From the intimations given in different parts of the Sacred Volume, we discover that there are various races of intelligent beings, not merely existing in the universe, but in some way, not very clearly explained, connected with our own earth, and interested in human affairs. This is only what might have been suggested as probable by a sound philosophy, independent of revelation. Up to man we behold one unbroken chain of existence, rising from the lowest state of organic life to the highest, by links beautiful in their combinations, and wonderful in their variety and extent. But at man, this astonishing fabric seems suddenly to stop short. The whole of these links appear to end in him; or, at all events, the continuation of the chain is no longer the object of our senses. When we consider the nature of man, it seems to be incredible that *he* should be the chief work of the Eternal; that a being so imperfect, so inconsistent, and so depraved, should crown the admirable structure of creation; that life should exist in such profusion, and in such amazing diversity of forms and powers beneath him, and that the glorious plan, commenced on so magnificent a scale, should have been suddenly broken off, just as the threshold of reason had begun to be entered. There is undoubtedly an infinite space between man and his Creator, in which intelligent beings might exist; and the amazing scheme might be carried upward in varieties which could never be exhausted, and in a progression which could never be completed. Are we to conclude,

then, that this space is left altogether unoccupied? The analogy of nature forbids the supposition, while Revelation confirms the argument from analogy, and assures us that the fact is otherwise.

There is, then, a world of intelligencies which is not the object of our senses. The chain is not broken off, or concentrated in man; it only vanishes from our imperfect vision. Man is the link which connects the rational with the irrational creation, but the faculties bestowed upon him do not enable him to trace the chain upward. Were he but to possess a sixth sense, a scene might be opened to him, similar to that which burst upon the assisted eye of the prophet's servant, when he saw the whole mountain filled with living beings invisible to our natural sight.

The analogy of nature seems further to render probable, that there may exist, in this unseen world, much moral degradation in connexion with high intellectual attainments. This, at least, is the case among men. Mental endowments, so far from insuring moral rectitude, seem frequently only to bestow greater force and malignity on evil inclinations. It appears hard to believe that this perversity should be extended to orders of superior beings, but scarcely harder than to believe that sin should exist at all in the universe of a holy God. Undoubtedly among the rational creation of mortals, sin has not only gained admittance, but a triumph; and it is merely following up this analogy to conceive that the same perversity may be found in higher races. Now, the Divine Record also confirms *this* analogy. It assures us that moral evil exists in the spiritual world, and that a rebel empire of wickedness is permitted by the Creator, for his own wise but inscrutable purposes, to be organized under a prince of stupendous power, and insatiable malignity. The dominion of this tremendous being has been extended over man, and his agency is disastrously connected with the history of our species.

The creation of our first parents in the full perfection

of their moral and intellectual powers, and the awful transaction by which a fatal revolution took place in the character and history of the human race, are recorded in the commencement of the Sacred Volume, and are too familiar to every mind, to require a particular description. Indeed, the extreme conciseness of the Revealed Word, with regard to this, as well as to other matters which strongly excite human curiosity, but are not necessary for spiritual edification, prevents the possibility of entering into minute details, without the danger of "darkening counsel by words without knowledge." It is, however, revealed, that when the Creator made to man the grant of vegetable food, he reserved from that grant one fruit-tree, which was to constitute a standing memorial of man's dependance, and of the Divine bounty; thus calculated to cherish in his heart a salutary sentiment of humility, when he regarded himself, and of gratitude, when he looked up to the Beneficent Giver. This reservation was also intended to serve as a test of submission and obedience. It was, in fact, man's only trial. His moral and intellectual faculties were so nicely adjusted, and his desires were so fully gratified, that he had no temptation to harbour one uneasy or undutiful thought. He had not a wish beyond the paradise in which he lived. But here one restraint was laid upon his liberty. There was only one; but, on that very account, it might be felt to be more galling in the first movements of a restless and impatient spirit. What could this prohibition mean? The fruit of the tree was "pleasant to the eyes;" it seemed to be delicious; it was surely wholesome, for it was formed by Him who made all things very good; certainly it was not created in vain; why should this form the only exception to the grant of food? There was something contrary to the usual dealings of a Paternal Governor in such an exception. Was it not needless? Was it not capricious? Could it really be intended?

Such might possibly be the progress of the temptation

in the mind of our first parents; and, while Eve was permitting the slow poison to work, the tempter came, and found her prepared for his malicious purposes. The interview it is unnecessary particularly to describe. It was the spirit of evil, full of subtlety, contending with unsuspecting innocence, in an unguarded hour. The contest was short and decisive. Man fell, and the power of darkness triumphed.

There are some most mysterious circumstances attending this transaction. With reference to the Divine Government, indeed, it concentrates in itself *all* mystery. Within the range of the human faculties, there is nothing embarrassing and incomprehensible in the administration of the Eternal, which may not be referred to the existence of moral evil, first manifested to the human race in this transaction. It had previously been introduced among a higher order of beings; it was henceforth to shed a blight on the history of man. We believe its truth; we see its unhappy consequences; we know also the remedy provided: we perceive an amazing scheme connected with it, full of ineffable grace, and overflowing love; but yet clouds and darkness brood around it.

"Lo, this only have I found," says Solomon, "that God hath made man upright, but they have sought out many inventions." It was doubtless, the abuse of free will implied in these words, which lay at the bottom of Adam's transgression. He was made free, and therefore liable to fall. Freedom of will is a property inherent in reason, and forming indeed part of its very essence. Deprive man of freedom of will in the exercise of his rational powers, and you deprive him of reason itself. You render him a mere machine, governed by external impulses. Man possessed this noble but dangerous gift. He abused it, and was ruined.

In turning to the subordinate circumstances of this transaction, one of the most remarkable appears to be, the assumption, by the arch-tempter, of the form of a

serpent. Our utter ignorance of many peculiarities in the state of existence, during those ages of innocence, renders it impossible to understand why this disguise should be the best adapted for gaining his end. That it was so, however, is intimated, when it is said, that "the serpent was more subtle than any beast of the field, which the Lord God had made;" and that he was afterwards degraded from his original condition, both in form and in faculties, appears more than probable from the tenor of the curse pronounced on this instrument of the Evil One:—"Because thou hast done this, thou art cursed above all cattle, and above every beast of the field; upon thy belly shalt thou go, and dust shalt thou eat, all the days of thy life."

But however this may be, it is at least certain, that the condition of the serpent has been, ever since the fall of man, what is described in these words; and the last and most emphatic part of the curse has also been fulfilled to the letter. "I will put enmity between thee and the woman, and between thy seed, and her seed; it shall bruise thy head, and thou shalt bruise his heel."

That these latter words, however, contain a deeper meaning than the literal phrase imports, has been constantly and universally understood by the interpreters of Divine Revelation. They contain, in fact, a prophecy of that glorious event predetermined in the counsels of the Eternal, by which the calamity of the fall was to be repaired, and that which was intended to mar the work of the Creator, was to afford a new occasion of causing his perfections to shine forth with additional splendour and loveliness. In a sense unspeakably superior to the literal, "the seed of the woman" has bruised "the head of the serpent."

EIGHTH WEEK—MONDAY.

REPTILES.—THE SAURIAN TRIBES.

If we are to believe geologists, there was a period in the history of the earth, when saurians, or animals of a similar type with the crocodile and lizard of the present day, held supreme sway over sea and land. This was the period of the secondary formation, when the ground is supposed to have been little elevated above the surface of the waters, and when almost interminable swamps and shallows required a peculiar form of animals, with functions, instincts, and habits accommodated to this state of the terraqueous globe.

"The peculiar feature in the population of the whole series of secondary strata," observes Dr Buckland, "was the prevalence of numerous and gigantic forms of saurian reptiles. Many of these were exclusively marine; others amphibious; others were terrestrial, ranging in savannahs and jungles, clothed with a tropical vegetation, or basking on the margin of estuaries, lakes, and rivers. Even the air was tenanted with flying lizards, under the dragon form of pterodactyles."*

Those who take an interest in geological studies, will agree with this author, when, in another part of his work, he says that, in reflecting on the large and important range assigned to reptiles, among the former population of our planet, many thousand years before the creation of its present inhabitants, "we cannot but regard with feelings of new and unusual interest, the comparatively diminutive existing orders of that most ancient family of quadrupeds, with the very name of which we usually associate a sentiment of disgust."

Of the order of saurians, which formed so distinguished a part of a former creation, the species which seems to

* Geology, Bridgewater Treatise, vol. i. p. 74.

approach nearest the type of this order of animals, as they existed in that early period, is the Gavial, or East India alligator. This formidable creature inhabits the borders of the Ganges. It differs from the crocodiles of Egypt, by having the jaws much narrower, and much more lengthened, so as to appear, in reference to the size of the head, very much like a beak. The teeth also are smaller and more numerous. Like the rest of its genus, it sometimes attains a very large size, compared with the other inhabitants of our present earth, extending to thirty feet; though the most enormous of them all would form a mere pigmy in the presence of some of the ancient race of the secondary formation.

The saurian reptiles, as they at present exist, may be popularly divided into crocodiles and lizards, each of which had its prototype in the monsters of the geological period to which we have alluded. The various tribes of this order differ much in form and habits. Some are extremely slow in their movements, while others change their place with great agility. Some frequent the waters, and always remain in their neighbourhood, while others, such as the common lizard, are found basking in the sun on barren heaths. The crocodile tribe shall at present be selected as a specimen of this order.

Nature, says Lacépède, has granted to the eagle the higher regions of the atmosphere; has given to the lion for his domain the boundless deserts of the hot climates of the world; and has abandoned to the crocodile the shores of the sea, and of the mighty rivers of the torrid zone. These immense animals, living equally upon the inhabitants of the sea, and on those which the earth nourishes, exceed in size every other creature of their own order. They divide their prey, neither with the eagle, as the vulture, nor with the lion, as the tiger, but exercise a domination greater than either. They are less easily extirpated, as their property of frequenting both land and water enables them more readily to avoid the snares of their enemies. The low temperature of their

blood, too, which endues them with the power of sustaining hunger for a considerable time, places them less frequently under the necessity of braving danger for the sake of satisfying their appetite.

Naturalists have added to the gavial of India, and the crocodile of Egypt, already mentioned, another distinct species, or rather family, that of the alligator of America. In all these three regions of the world, where extensive swamps and lagoons exist under a burning sun, or broad rivers flow slowly, through low and reedy banks, these monstrous animals dispute possession with man, their only formidable enemy.

"In Louisiana," says an American author, speaking of the alligator, "all our lagoons, Bayous, creeks, ponds, lakes, and rivers, are well stocked with them; they are found wherever there is a sufficient quantity of water to hide them, or to furnish them with food; and they continue thus, in great numbers, as high as the mouth of the Arkansas River, extending east to North Carolina, and as far west as I have penetrated. On the Red River, before it was navigated by steam-vessels, they were so extremely abundant, that to see hundreds at a time along the shores, or on the immense rafts of floating or stranded timber, was quite a common occurrence, the smaller on the backs of the larger, groaning and uttering their bellowing noise, like thousands of irritated bulls about to meet in fight; but all so careless of man, that, unless shot at, or positively disturbed, they remained motionless, suffering boats or canoes to pass within a few yards of them without noticing them in the least. The shores are yet trampled by them in such a manner, that their large tracks are seen as plentiful as those of sheep in a fold."

The insensibility to the presence of man evinced by the alligator on the banks of the Red River, is only one instance of a fact well known to travellers, that, in unfrequented parts of the earth, that dread of the human race, which seems instinctive to the lower animals where

they mingle with man, is almost unknown. Cowper beautifully alludes to this remarkable circumstance in the soliloquy he puts into the mouth of Robinson Crusoe,—

" I am out of humanity's reach ;
I must finish my journey alone ;
Never hear the sweet music of speech ;—
I start at the sound of my own !
The beasts that roam over the plain,
My form with indifference see ;
They are so unacquainted with man,
Their tameness is shocking to me."

The common crocodile is the species well known as frequenting the rivers of Africa. In the central parts of that continent, they are said to attain the enormous size of the gavial of India. On the banks of the Nile, however, their dimensions are smaller, it being a striking fact, that where man has taken up his abode, all the animals hostile to his prosperity dwindle in size, and become diminished in ferocity, owing probably to their circumscribed bounds, and the privations to which they are subjected by the tremendous force and influence of human reason. These animals are capable of being tamed. Bruce mentions, that in Abyssinia, children may be seen riding on their backs; and it is a well known historical fact, that the priests in the temple of Memphis in Egypt, in the celebration of their heathen mysteries, were in the habit of introducing tame crocodiles to the deluded multitude as objects of worship. They were fed from the hands of their conductors, and decorated with jewels and wreaths of flowers.

If we inquire into the office assigned to these horrid creatures in the economy of the Author of Nature, we shall find it sufficiently evident, that they belong to the class intended as checks on over-production ; and that the existence of some such devourer of animal life in the prolific regions which they haunt, is, upon the

whole, a blessing, it is not difficult to conceive. The alternative of animals increasing in numbers, till they die of starvation as they are produced, is too distressing to be reflected on without shuddering; and yet, unless there were a system of checks, such as we find to exist in carnivorous animals, this would be the necessary result. One of the ways in which this check practically operates in the case of the alligator, may be understood by attending to the following graphic description of its operations during the dry season, given by the traveller from whom I have already quoted:—"Each lake has a spot deeper than the rest, rendered so by those animals, who work at it, and, always situated at the lower end of the lake, thereby insuring themselves water as long as any will remain. This is called by the hunters the alligators' hole. You see them there lying close together. The fish, that are already dying by thousands, through the insufferable heat and stench of the water and the wounds of the different winged enemies constantly in pursuit of them, resort to the alligators' hole to receive refreshment, with a hope of finding security also, and follow down the little currents flowing through the connecting sluices. But no! for as the water recedes in the lake, they are here confined. The alligators thrash them, and devour them whenever they are hungry; while the ibis destroys all that make towards the shore."

There is a strange mixture of wisdom and folly in the human character; and the latter quality can scarcely be exhibited in stronger operation, than when it erects the crocodile or the serpent into an object of religious worship, and causes intelligent man to bow the knee before the lowest and most malignant orders of the brutes. It exemplifies, however, this important truth, that terror takes a prominent place in the devotions of unenlightened men, and is, indeed, the groundwork of all superstitious belief. It is not till the human mind is emancipated and enlarged by revelation, that this emotion is

changed into the ennobling feeling of veneration, or gives place to the still more exalted and generous sentiments of love, gratitude, and pious confidence. I can make no exception in favour of the deist of the present day, both because his religious feelings, when they exist at all, are very often unconsciously modified and enlightened by a Christian education, and because, when that is not the case, they consist either in cold abstractions, or in a feeling of mere sentimentality.

EIGHTH WEEK—TUESDAY.

BIRDS.—THEIR RELATIVE POSITION.—THE BILL.

As we advance in the scale of being, new wonders strike our view, which furnish us with additional illustrations of the Divine perfections. From reptiles, the transition to birds is a great and sudden step; and we are introduced at once into a new system, in which the contrasts are not less numerous and remarkable than the analogies; but in which the intention of all the differences is obvious, and the adaptation to new functions and conditions is beautiful and complete.

When we examine the structure of birds, we find that it is more complicated than that of the animals we have already been contemplating, though inferior in this respect to the quadruped races. If we consider the mental powers with which they are endowed, it will appear that these also are intermediate between the same classes; but, if we regard the functions they are destined to perform, we shall discover in that which is their distinctive property, a superiority not merely over the order of quadrupeds, but over man himself.

The power of moving through the air is a very remarkable endowment, which, though it be shared with insects, may be considered, among vertebrated animals,

as the peculiar property of birds. It is true, indeed, that there is scarcely any power, however peculiar, belonging to a great order of organized beings, to which we do not find approaches in species of another order: and this holds true of the power of flying. If we turn to the finny tribes, we find this quality partially possessed by the flying fish; if we regard reptiles, the same thing may be said of the flying lizard; if we look upward in the scale, we discover among quadrupeds also a connecting link in the bat and the vampire. These, however, are exceptions to the general rule in their respective classes, and merely serve to follow out that remarkable law of nature, by which all orders, classes, and species, seem to run into each other, so as to exhaust almost all the possible forms and functions of organized existences, and to fulfil the beneficent intention of peopling creation with interminable varieties, up to the extent of its varied resources.

As another instance of the approximation of two distinct and even distant orders to each other, I may mention that of the humming-bird to the insect tribe. These interesting little creatures, while, like the bee, they emit that peculiar sound, in flying, from which they take their name, flutter from flower to flower, and suck nectar like the butterfly, for which, on a casual glance, they might easily be mistaken. Their tiny bill is a rival to the proboscis of the insects I have mentioned.

In a former part of this work I adverted, at some length, to the contrivances whereby birds have been fitted to the element through which they were designed to find their way;* but there is much relating to the peculiarities of this order of beings which has been left unsaid. In the remainder of this paper, I shall confine myself to a single member, with regard to which a few particulars shall be mentioned, which exhibit striking adaptations.

* "Spring."—On the Relation of the Bodies of Birds to External Nature.

The bill of a bird is very peculiar in its conformation, and has obviously been formed with reference to the structure and functions of the animal in other respects. It was intended to cleave the air in flying, and therefore it was of importance that it should be sharp and pointed, and should project from a small head; and it was designed to act as an instrument of defence, and as a hand by which to seize its food, and, in birds of prey, to tear it. Had a mechanic been called upon to construct a mouth for such an animal, he would certainly, with all his ingenuity, have failed to invent so perfect an instrument as a bill.

But it is not merely in the general type, it is also in the variations for particular purposes, that the skill of the Creator is exhibited. Take the bill of the domestic fowl as the general basis of the contrivance, and we have an instrument simply but admirably fitted to act at once as a mouth and a hand, having nothing to do but to pick up food, to arrange its nest, and to plume its feathers, or to defend itself when attacked. If we compare it with the bills of other species of the tribe called *Passeres*, to which the domestic fowl belongs, we shall find numerous variations even in this simplest form. The blackcock, the pheasant, the bullfinch, and the lark, may be mentioned as examples. But take other orders, and the variation becomes still more marked. There are tribes which feed on worms and larvæ residing deep in the earth, and requiring to be reached by an elongated instrument. Such an instrument has been bestowed on them. The lengthened bills of the curlew, the woodcock, and the plover, are of this description. The mechanical contrivance is here simple and obvious. But more skill was required to form a forceps of horn capable of distinguishing a soft worm among the equally soft mud in which it was embedded: In the woodcock, and feeders of this kind, the end of the bill is not horny, but is provided with nerves, so that it becomes a finger to feel, as well as a hand to hold, and a mouth to eat.

" It is doubtful," says Dr Macculloch, " if the most delicate human finger could feel the food of a woodcock where it lies. But there is even more of contrivance, if I mistake not, in this provision. The nerves are large beyond all apparent necessity; utterly disproportioned to a nerve of touch in any other animal body. It was necessary that the point of the bill should be tough and firm; and the magnitude of the nerves forms a compensation for this."*

The duck and other flat-billed birds, form another variety, whose instruments are intended for a purpose somewhat similar. They have to obtain their food in mud below the water. Here the teeth form a strainer, like the same engine in the whale, while a highly sensitive bill and tongue aid each other in separating what is wanted, and rejecting what is superflous.

The birds of prey exhibit a conformation adapted to their purpose, not less effectual than it is simple. It consists in giving to the upper mandible a crooked form, which affords the animal much power in holding and tearing the flesh off its prey. It would be easy to follow out this enumeration, by other cases of remarkable adaptation, such as that of the swallow and the nighthawk, which feed on insects while on the wing, and have therefore a wide mouth, into which their prey may be said to fly; the crossbill, whose instrument is so admirably adapted for opening the cones of the fir; and the spoonbill, which is literally furnished with a pair of tongs, for catching frogs. But the alterations to effect special ends are as various as the ends themselves; and enough has been said to show, that inventive wisdom has been at work not merely in contriving the instrument, as regards its general type, but also in effecting those deviations which are so remarkably suited to the

* Macculloch's " Attributes of God," an excellent posthumous work, just published (1837), to which the reader will find, that I am much indebted in the remaining part of this volume. I feel great pleasure in announcing this new coadjutor, in a department of study at once so delightful and so edifying.

peculiar wants and habits of each particular class and species.

Were we to pass from the bills to the eyes of the winged tribes, we should not find less reason for admiration. The largeness of the organ in comparison with the size of the animal, its horny structure, and nictating membrane to protect it from injury, the amazing keenness of sight in birds of prey, and a variety of other particulars, proving studious adaptation to circumstances, might be mentioned; but the vision of birds is a subject worthy of distinct consideration.

Meanwhile, I conclude this paper by remarking, that the instances I have selected are connected with a system which extends to the whole animated creation, and forms a most interesting department in comparative anatomy. Take, for example, the mouth of animals, and follow this organ through all its varieties among insects, reptiles, quadrupeds, and fishes, as well as among birds; examine the variations in structure under each type, in reference to the order, the family, and the species, and proofs of most curious and skilful adaptation will break in upon you in whatever way you direct your attention, which cannot fail at once to delight the mind and elevate the devotional feelings.

EIGHTH WEEK—WEDNESDAY.

BIRDS.—THEIR POWER OF FLYING.

In a chapter on the modes of motion in animals, Dr Macculloch makes some very ingenious and striking remarks on the relative means of progression belonging to different orders; and he shows, by an analysis of these, how admirably such means are adapted to the nature and the functions of the animals on which they have been bestowed. The following are his observations with re-

lation to the winged tribes, which I have somewhat abridged :—

" In turning to the mode of motion through flying, I shall scarcely be contradicted in saying, that if a mechanician had known no animals but quadrupeds, he would not have believed that a creature of great weight could have been constructed to fly through the air, and to rest on it, with as much security as those walk and rest on the ground; and still less would he have suggested the means. A philosopher, at least, accustomed to abstraction, will admit this; whatever difficulty may be found by those who believe their familiar knowledge to be necessary and innate, forgetting how it was acquired. Yet this problem is effected, widely, in respect to the velocities and the varieties of this mode of motion, and in a very remarkable manner, as regards the weights thus sustained and moved; so unimportant are difficulties, under the resources of the Creator.

" The general construction for this purpose, under what is a mere variation from the form of the quadruped, is already understood, in the conversion of the fore extremities into wings; the enlargement of the breast-bone, with its powerful muscles; the extent of the lungs; the hollowness of the bones; and the levity, compact arrangement, and length of the feathers, to which I must add the form of the body, and the smoothness of the surface, the first constituting one of those figures, which, as in fishes, mathematicians are pleased to term solids of least resistance, though far from having yet mastered that difficult branch of analysis, in either case.

" The form, position, and action of the wings constitute the principle of motion, the two first differing little in the several kinds, otherwise than in spread or length, but the latter varying considerably. The motions used in flying are familiar; but it is not so obvious how progression is the consequence of what appears to be a series of vertical alternate impulses on the air. A mathematician should find no difficulty, through his doctrine of

the resolution of forces; but they who are not familiar with this science, yet who know that a ship can advance under many obliquities of the wind on its sails, and who will recollect that the motion of the wing is equivalent to that of the breeze, will form a sufficient conception of the subject, from the following facts, which they may not have analyzed. The impulses are not vertical, but obliquely curved, backwards and forwards, from that line to the horizontal; while the convexity of the wings, with the comparatively feeble action of the corresponding muscles, diminishes the resistance forwards; as their concavity, with the rapid and powerful action downwards and backwards, and especially in the latter direction, gives the impulses for motion. In the different positions of the wing also, it is a sail, acted on by a more or less favourable oblique wind; going "large" when in its most favourable position, and "near the wind," when in the least; while, as in the ship, the progressive impulses are aided by the form of the bird, and, while those inevitable ones in a vertical direction, which follow from the necessary construction, are checked by the lateral resistance, and further balanced against each other, so that there is no lee-way. That lee-way, it is plain, would be upwards; and it can be produced, for the purpose of ascending, by modifying the action of the wings, as is done by the lark. All else is simple; and, if the bird advances against the wind, it is merely because the motion of the wing is the more rapid of the two; it is a stronger opposed breeze. The tail, as all know, is used for balancing; yet it occasionally assists in the steerage; this also is the proper office of the wings.

"There are not many variations in this motion, requiring notice for the present purpose: but such as they are, there is an object and use in them all, and slight differences in action and form accomplish everything. In the sea-birds which neither dive nor swim, long flights and great duration were necessary, because their food is often rare, and wide apart, and far also from their

homes. Hence the great and untiring powers of the gull and the gannet, and of the albatros above all, the velocity of which is also said to amount to 100 miles in an hour. If greater muscular powers have been conferred in these cases, so has a larger wing; while this is one of those unnoticed contrivances for saving exertion, the wisdom of which is apparent as soon as it is stated. The short-winged sparrow must close its wing to the sides, as must the partridge, frequently and with great force, that it may gain sufficient velocity; whence the noisy flight of those birds, while they are also unable to maintain it very long. The sea-fowls in question need not labour so hard: the size of their sails is a compensation for that slighter exertion, under which they are always "nearer the wind." In the far-migratory birds, the arrangements are similar; there is great muscular power, or great spread of wing, or both. If the short-winged small birds sometimes migrate, it is to short distances, as we know that they are also often drowned at sea; but the general rule will be found to hold, as is familiar in the wag-tail, the lark (requiring long wings, however, chiefly for the sake of its peculiar flight), and others.

"If the swallow demanded long wings and great power, for the same reason as the sea-birds, still more were these necessary for the pursuit of its agile and scarcely perceptible prey; not attainable, had it not possessed the power of suddenly changing the line of its flight; and to this is added the highest known velocity in birds, since the motion of the swift has been computed at seventy feet in a second. In many other birds, where similar angularity and rapidity of movements were required, for the same or analogous purposes, there are appropriate arrangements, in the actions or in the wings themselves; while all those, especially, which pursue a small and active prey, display that universal agility of movement, which confers so pleasing a character of liveliness on this most cheerful part of the creation. The wag-tail, pursuing on the ground what the swallow does

in the air, seems incapable of keeping itself at rest; ever in motion, because it is not so easy to begin to move from a state of inaction; and thence probably the length of its apparent superfluity of tail. In the falcon tribe I need not repeat what I said of the sea birds: but that peculiarity of motion necessary for watching the movement of their prey on the ground, is no less a distinguishing feature. Nor is the power of hovering so mysterious as it often appears. The bird, in this case, is a light parachute, of considerable extent, only requiring that its balance be preserved, by a slight exertion of the tail and the point of a wing, easily moved, or restored to its place by a very slight impulse, and opposing no surface to the wind, which the bird cannot easily counteract. In the fluttering repose, the wings are caused to act vertically alone; and thus a fixed position is easily maintained. In the humming-bird, there is the same power, for a well known purpose."*

EIGHTH WEEK—THURSDAY.

BIRDS.—THEIR POWER OF VISION.

The vision of birds is not less remarkably adapted to their situation and necessities, than their faculty of moving through the air. In this order, the formation of the eye has several peculiarities, with regard to the nature of which, in some particulars, physiologists are not altogether agreed; but it is well known, that this organ is in birds proportionally larger and more prominent than in other animals, which enables them to command a more extensive range of vision; that the substance of the eye is more hard and horny, which compensates for the danger to which its prominence subjects it; that its nictating membrane is admirably contrived, as an additional security against peril from branches of trees, or

* "Attributes of God," vol. ii. pp. 100-105.

other objects, with which its habits render it liable to come in contact; that its power of altering the focus of vision, in certain tribes, is peculiar and great; and that there is yet another part of the organ, whose use has not been very clearly ascertained, but which is supposed powerfully to assist the sight, called by the French Academicians, the purse or comb.

Without dwelling further on the general structure of the eye in this class of animals, I shall notice some circumstances which practically show a very striking adaptation of the faculty of vision in various species to their habits and wants. And I begin by observing, that night-birds have their eye peculiarly formed for seeing in the twilight. M. de Blainville remarks, that, besides being comparatively very large, this organ is, in the class alluded to, flat, both before and behind, while the transparent cornea is placed at the end of a sort of tube. The retina is consequently large and extended, as well as the iris, while the membranes, being probably more soft and delicate, are more susceptible of impressions from a small quantity of light. The owl and the woodcock are of this description. These species, the former in particular, though by no means of acute vision by day, are remarkably quick-sighted in the evening, when they stir abroad in search of their slumbering prey.

But it is to instances of *day* vision that I intend particularly to devote this paper; and the first example I shall adduce is that of the carrier-pigeon. It is believed that the remarkable faculty by which this bird finds its way to its distant home, is almost exclusively its power of sight. This opinion is supported by the manner in which it executes its journeys, so far as this has been ascertained. When let off from a low station, in an unknown locality, it rises by irregular excursions to a certain height, and then commences its route by a rapid flight in gyrations, taking in a larger and larger space at every turn, and thus obtaining a complete survey of the whole district in every direction; and it is supposed to

continue this circular motion till some known object arrests its vision, and makes it aware of its position, when it darts forward with incredible velocity in the right direction. If liberated from a balloon, when high in the air, the bird drops perpendicularly downwards, till it come within such a distance of the earth, that it can distinguish landmarks, and then commences its wheeling flight, as already described.

If this account be correct, the velocity of the carrier-pigeon is indeed incredible. M. Antoine relates, that a gentleman of Cologne, having business to transact at Paris, took with him two carrier-pigeons; and, having arrived at the metropolis, he tied a letter to each of his pigeons, and dispatched them at eleven o'clock precisely. One of them arrived at Cologne at five minutes past one o'clock, and the other nine minutes later, having thus completed a journey of 300 miles in little more than two hours! This was at the rate of nearly 150 miles an hour, supposing their flight had been in a direct line. If it was circular, as observation would lead one to suppose, the extent traversed must have been immensely greater.

Audubon gives a similar, though considerably less marvellous, account of the velocity of the American pigeon. He says, that pigeons have been killed, in the neighbourhood of New York, with their crops full of rice, which they must have collected in the fields of Georgia or Carolina, these districts being the nearest in which they could have procured a supply of this kind of food. "As their power of digestion is so great, that they will decompose food entirely in twelve hours, they must in that case have travelled between 300 and 400 miles in six hours, which shows their speed to be, at an average, about one mile in a minute. A velocity such as this would enable one of these birds, were it so inclined, to visit the European continent in less than three days." This naturalist goes on to observe, that the great power of vision possessed by the pigeon, enables it, as it travels

at that swift rate, to inspect the country below, and discover its food with facility, which he has ascertained by observing, that when traversing barren tracks, they keep high in the air, to descry distant lands; whereas, when the country is fertile, they fly lower, to fix on the part most plentifully supplied with food. "As soon" he graphically adds, "as the pigeons discover a sufficiency of food to entice them to alight, they fly round in circles, reviewing the country below. During their evolutions on such occasions, the dense mass which they form exhibits a beautiful appearance as it changes its direction, now displaying a glittering sheet of azure, when the backs of the birds come simultaneously into view; and anon suddenly presenting a mass of rich deep purple. They then pass lower over the woods, and are for a moment lost among the foliage; but again emerge, and are seen gliding aloft."*

It would appear, from an observation of Professor Lichenstein, that birds which feed on carrion may probably resort to circular flights, similar to the pigeon, in order to discover a carcass. He remarked, while travelling in southern Africa, that if an animal chanced to die, in the very midst of the most desert wilderness, in less than half an hour there was seen high in the zenith, a number of minute objects descending in spiral circles, and increasing in visible magnitude at every revolution. These were soon discovered to be a flight of vultures, which must have observed, from a height viewless to the human eye, the dropping of the animal immediately marked out for prey.†

Dr James Johnstone mentions a fact illustrative of the same view. During the north east monsoon, when the wind blew steadily in one point for months in succession, he observed a concourse of birds of prey from every quarter of the horizon, hastening to a corpse that was floating down the river Ganges. Their sudden appearance he accounts for in the same manner as Professor

* Ornithological Biography, p. 333. † Travels in Africa.

Lichenstein, by their soaring high in the air in search of food. It could not be owing to the acuteness of scent, as they crowded in from the points from which the wind blew, as well as in the opposite direction. It has indeed been ascertained, by positive experiment, that vultures, and other birds of prey, are guided to their food by the sight, and not by the smell. Audubon, being desirous of satisfying himself on this point, caused a large dead hog to be concealed in a narrow and winding ravine, which was filled with briars and high cane. This was done in the month of July, in a tropical climate, where putrefaction takes place with great rapidity. Yet, though many vultures were seen, from time to time, sailing in all directions over the spot, they seemed perfectly unconscious of its presence, while the dogs found their way to it, and devoured the flesh. On the other hand, when Audubon stuffed a deer-skin full of hay, and laid it down on its back, in the attitude of a dead animal, it was, in the course of a few minutes, visited by a vulture, which tore open the dried skin, and did not retreat till it had torn out large quantities of the hay, and perceived that there was no flesh within. These experiments seem to be conclusive.

EIGHTH WEEK—FRIDAY.

BIRDS.—THEIR VOICE.

When a little quaker girl of my acquaintance was once humming a tune in the presence of a stiff maiden aunt of the same profession, the old lady, scandalized at what she considered an unbecoming levity, said to her reproachfully, "Rachel, who taught thee to sing?" On which the child archly replied, "It was the little birds, aunt, that taught me to sing." There was much truth as well as sweetness in this reply. It is the hand of the Creator which has given the power of song to the birds; and it is the same hand which has bountifully gifted

man with a musical ear, and a musical voice. The inference is irresistible, that music is intended to add to the enjoyments of the human race; and that to refuse the gift, is to show equal ingratitude to the Giver as when we abuse it.

There is something at once peculiar and delightful in the musical intonations of the feathered tribes, which affords a clear indication of beneficent design. The music of the groves has always been a favourite theme with the poet; and civilized man is probably more alive to the pleasure derived from this source than the savage; but there is no class of rational beings to whom the song of the little warbler is not a source of enjoyment. Let any man consider for a moment how much would be detracted from the delights of the early summer months, if the feathered tribes were dumb, and he will be better able to appreciate the beneficence of the provision, as regards the human race.

But we must never forget, that the Universal Parent has not confined his paternal care to man alone. It is pleasing to see the same attention paid to the lower creation, up to the extent which their humbler sphere requires. The songs of birds, which are so agreeable to us, are probably more delightful, and far more significant to the respective tribes which give utterance to them. They are to them the language of conjugal affection, of parental love, of triumphant exultation, of social enjoyment. They animate and urge forward the labours of nest-building; they cheer the tedium of incubation; they infuse joy into the hearts of the callow brood; they bid defiance to enemies, and inspire friends with confidence.

But the voice of birds is not confined to musical intonations. Their Creator has bestowed upon them the power of communicating with each other in a still more extensive manner; and although they are incapable of uttering articulate sounds, these tribes, as well as other orders of the lower animals, may in a limited sense be

said to possess the power of intercourse by means of a natural language, the utterances of which are instinctively understood by each species respectively. Dr Macculloch's work contains some curious and ingenious remarks on the language of the lower animals, which may, perhaps, in some particulars, be rather overstrained, but which deserves serious consideration. He alleges, that the ears of these animals are more susceptible of a minute distinction of sounds, than those of the human race; and hence infers, that they have a greater variety in their language than we can properly comprehend. "In the nightingale and thrush," says he, "we distinguish a great number of sounds and articulations, because they belong or approach to that musical scale for which our sense of hearing is adapted. But we cannot doubt, that in these, and still more in birds whose tones are less musical and definite, there are sounds which we do not truly distinguish, and which we, therefore, neglect, in favour of those to which we are most sensible. And there is no difficulty in believing, that the song of a nightingale is better understood by itself than by us, or that it contains much more than we hear. If I were to suggest that it contains a definite set of phrases, with meaning to the animal itself and its kind, there would be nothing absurd in the proposition, since it possesses, even to our ears, a greater variety of articulation than we can find in any human language with which we are acquainted; while, in confirmation of this general view, all who have attended to such subjects must know, that where these birds abound, long debates are often carried on among them, in tones and articulations quite distinct from the ordinary songs. When we decide otherwise, we are deciding from a prejudice, or assuming that it is not a language, because we do not understand it. We should be equally justified in thus deciding as to the Arabic."*

* Attributes of God, vol. i. p. 559. Dr Macculloch strengthens his argument by a learned dissertation on the nature of musical sounds, and defects in the human ear, on which I do not think it necessary to enter.

Having shown that the lower animals may possess language more definite than at first sight we might be inclined to believe, Dr Macculloch proceeds to instance cases in which this faculty may, at least to a certain extent, be proved to exist. Confining myself at present to the case of birds, I quote the following remarks:—

"Familiar examples of various and vocal language exist in the duck tribe, followed by corresponding actions, in marshalling their flights, and in much more. The sounds and articulations of the domestic duck and goose in particular, are so numerous and marked, that they are not equalled by any human language; while it is not difficult to learn the definite if the general, meaning of many of them. It is not easy to see how else the decoy duck can perform her treacherous office." "In the endeavour of birds to persuade their progeny to fly and to dive, we can scarcely avoid believing that we hear a definite language, so unusual, and varied, and marked, are the articulations and the tones. The quarrels of sparrows are more articulate, and the noises more varied, than those of a human contest. The sounds of the domestic fowl under the approach of a hawk, the intention to sit, the calling its young to feed, and much more equally familiar, are not less various and definite. But, not to encumber these pages with facts that all can supply, I need only add the equally noted cases of the cat and the rook. However distinguishable the sounds of the former may be to us, they abound in variety of expression; and in the latter, the combinations of actions and sounds, under a fact of familiar occurrence, renders it scarcely possible to avoid concluding, that the latter constitute a language. The destruction of a rook's nest occasionally proceeding to the slaughter of the animal, is preceded by a congregation of the society, and a great noise; and all know that the work is executed by the deputation of two or three individuals out of this convention."

These observations, and others made by this author on the power which the lower animals have of communica-

tion by sound, are doubtless founded in truth, although they appear to be carried too far. That birds and other creatures have, to a certain extent, the power of conveying their meaning to others of their own species, by the different intonations of their voice, there can be no doubt; but it is equally true, that this power is as limited as their mental faculties, and their mutual necessities of communication; and although such a faculty may be dignified by the name of language, yet that term must then be employed in a very restricted sense. As far as it goes, however, it is a provision which must greatly contribute to the happiness of the animals possessing it. The [illegible] which is created among the members of a [illegible] family, commencing with the mates when they begin to pair, and extending through all their mutual labours, till the connexion ends, if it does end, in the production and education of the brood, tends, doubtless, to endear and [illegible] their intercourse, while it lightens their various employments; and, in the gregarious tribes, the communication which is thus effected of hope and fear, of pain and enjoyment, as well as of some other kinds of information useful to their subsistence, or their escape from danger, promotes not less truly, though in a less important sense, the welfare of the individuals and of the species; thus affording another instance of paternal regard in the great Author of Nature.

EIGHTH WEEK—SATURDAY.

BIRDS.—THEIR SELECTION OF FOOD.

It is the obvious intention of the Creator that every kind of production fit for the food of animals should be devoured. Nothing can be more curious and admirable than what may be called the economical arrangements which have been adopted for this purpose. Every kind of herb, and flower, and fruit, every kind of succulent

vegetable, in short, has some species of living creature which subsists on its produce; and animals themselves are, respectively, objects of preference as food to different classes of the animated creation. Some species, for example, exclusively devour insects, others fishes, others fowls, and others quadrupeds, while others again are omnivorous. And what is not less worthy of remark is, the nice selection which some animals make, not merely of a particular class of animals or vegetables, but of particular kinds of that class. This is, doubtless, intended by the Author of Nature, for the purpose of ensuring a more complete execution of His great design of rendering every thing useful, and thus spreading a "liberal feast for all that lives." There is in this appropriation of particular kinds of food by particular animals, an effect produced something analogous to the division of labour. The work is better done.

Among birds, this kind of selection is singular, and a few facts connected with the subject may not be uninteresting. "Our gardens, shrubberies, and orchards," says Mr Knap, speaking of the smaller kinds of birds, "become their resort, seeking for the fruits usually produced in those places. And first the fannette (*philomela hortensis*), with all their matured brood, is certain to be found feeding voraciously upon our cultivated berries, or mining a hole in the fig or jargonel pear; and so intent are they upon this occupation, that they will permit a reasonable examination of their form and actions; but at other periods, it is difficult to approach them." After mentioning, also, in his characteristic style, the black cap and the white throat tribes, along with others, he adds:—"All these fruit-eating birds seem to have a very discriminating taste, and a decided preference for the richest sorts, the sweetest variety of the gooseberry or the currant always being selected; and when they are consumed, less saccharine dainties are submitted to; but the hedge-berry of the season our little foreign connoisseurs disdain to feed on, leaving it for humbler-appetited

natives; they are away to sunnier regions, and more grateful food."*

Mr Rennie mentions, that these species are equally nice in their preferences and rejections of insects and other small animals, on which they also feed. "We had a fauvette, for example," says he, "which was exceedingly fond of spiders, the largest of which he would contrive to swallow; but the black-cap, though it will devour flies of every sort, will not touch a spider; and while it will eat almost any smooth caterpillar, it will not touch those of the cabbage-butterfly, which the fauvette devoured with avidity. Neither of these birds, again, nor the nightingale, will touch an earth-worm, of which the redbreast is very fond. No bird will touch the caterpillar of the magpie moth."†

There is, then, an obvious choice of food in these birds, which indicates taste; and the same thing may be averred of many other species. It seems difficult, however, to say where this faculty resides, as they swallow their food without mastication, and as their tongues seem generally destitute of those papillæ,‡ on which the taste of quadrupeds and man depends. Blumenbach and other distinguished naturalists have, indeed, founding on these peculiarities, denied that birds are possessed of the faculty of taste; but their habits prove, that they have, at all events, some analogous property which answers the same purpose.

The tastes and preferences of birds with regard to food, are evidently regulated by reference to their organization, there being a beautiful consistency between instincts and bodily conformation, which marks as distinctly as innumerable other adaptations, the work of a

* Journal of a Naturalist, p. 232, 3d edition.

† Faculties of Birds, p. 81, 82.

‡ The flamingo is an exception to this rule, the tongue of this bird being remarkable for being edged with fleshy papillæ, turned backward. This member of the flamingo has been celebrated among epicures, since the classic ages, as a great delicacy. Ducks, parrots, and various other birds are also furnished with papillæ.

Designing Cause. There is a striking passage in Buffon, illustrative of this, which I shall quote entire.

"The mode of life, the habits and economy of animals, are not so free as might be supposed. Their actions result, not from inclination or choice, but are the necessary effects of their peculiar organization and structure; nor do they seek ever to infringe or invade the law of their constitution. The eagle never abandons his rocks, nor the heron her shores; the one shoots down from the aerial regions to plunder, or murder the lamb, founding his prescriptive right on his strength, his weapons, and his habitual rapine; the other, standing in the mire, patiently expects the glimpse of its fugitive prey. The woodpecker never forsakes the trees round which he is appointed to creep: The snipe must for ever remain in the marshes, the lark in its furrows, and the warbler in its groves. All the granivorous birds seek the inhabited countries, and attend on the progress of cultivation; while those which prefer wild fruits and berries, perpetually fly before us, and cherish the wilds, and forests, and mountains; there, remote from the dwellings of man, they obey the injunction of Nature. She retains the hazel-grous under the thick shade of pines; the solitary blackbird under his rock; the ousel in the forests, which resound with its notes; while the bustard seeks its subsistence on the dry commons, and the rail in wet meadows. Such are the eternal, immutable decrees of Nature, as permanent as their forms; these great possessions she never resigns, and on these we vainly hope to encroach. And are we not continually reminded of the weakness of our empire? She obliges us even to receive troublesome and noxious species: The rats make a lodgement in our houses, the martins in our windows, the sparrows in our roofs; and when she conducts the stork to the top of our old ruinous towers, already the habitation of the mournful family of nocturnal birds, does she not hasten to resume the possessions which we have usurped for a time, but

which the silent lapse of ages will infallibly restore to her?

"Thus the numerous and diversified species of birds, led by instinct, and confined by their wants, to the different districts of Nature, have apportioned among themselves the air, the earth, and the water. Each holds its place and enjoys its little domain, and the means of subsistence which the peculiarities of its faculties will augment or abridge. Thus the spoonbill seems formed for gathering shell-fish; the small flexible strap, and the reflected arch of the avoset's bill, reduce it to live on fish spawn; the oyster-catcher has an axe-shaped bill, calculated for opening the shells; and the crossbill could not subsist, were it not dexterous in plucking the scales from the fir cones. Lastly, the shearbill could neither eat sidewise, nor gather food, nor pick forwards; its bill consisting of two pieces extremely unequal, the lower mandible being long, and extended disproportionally, projects far beyond the upper, into which the latter falls like a razor into its haft."*

* *Oiseaux, Art: Le Bec-en-oiseaux.*—Buffon seems not duly to appreciate the wisdom of this contrivance in the shearbill, and in his observations on the subject, casts reflections on Creative Intelligence. He speaks of it as "an awkward and defective instrument;" yet he himself informs us, that "it flies skimming the surface with its lower mandible cutting the water;" and he quotes M. de la Borde, who says that it is with this very instrument that it seeks for its prey below the surface of the water, "and when it feels a fish it closes both mandibles." The truth is, that the instrument, so far from being "awkward and defective," is most admirably suited to the peculiar instinct of the bird; and, on account of its singularity, is calculated advantageously to show the reciprocal adaptation of habits to instruments, and instruments to habits.

NINTH WEEK—SUNDAY.

THE ASCENSION OF CHRIST.

After his resurrection, Jesus remained for forty days on the earth, appearing occasionally to his disciples, and instructing them in heavenly truths; and it was about this season of the year that "He led them out as far as Bethany, and he lifted up his hands on them and blessed them; and it came to pass, while he blessed them, that He was parted from them, and carried up into heaven. And they worshipped him, and returned to Jerusalem with great joy."

On the first glance it may appear strange and unnatural, that the disciples should rejoice at an event which deprived them of the personal presence of their beloved Master, in whose society they had hitherto received so much instruction and delight; but if we consider their situation, and the circumstances attending this wonderful event, a little more minutely, we shall see the matter in another light. It was awful and heart-rending, indeed, to see Him whom they loved, expiring on the cross; but his departure was *now* stripped of all that could give pain to the generous heart; and their attachment to him was too sincere and disinterested to permit them to place their own selfish interests in competition with his happiness. This event restored him to the bosom of his Heavenly Father; and they must have remembered the irresistible appeal which he had himself made to their feelings on the very night before he suffered:—"If ye loved me ye would rejoice." Besides, they consoled themselves with the blessed assurance that he was only parted from them for a season, and that after a few fleeting years of earthly pilgrimage, they would be reunited to him in the regions of eternal glory. This ground of consolation he had also suggested to them

on the same occasion:—"I go," said he, "to prepare a place for you; and I will come again to receive you to myself, that where I am there ye may be also." In a word, the hope of earthly power and greatness, which they had formerly cherished, they now found to be delusive; but their hearts were purified from worldly affections, and in the ascension of Jesus they contemplated the pledge of celestial enjoyments, infinitely more substantial and durable in their nature, and inconceivably better suited to the spiritual faculties of the soul.

These sources of pleasure in the contemplation of the Saviour's ascension, must have been experienced in a peculiar degree by the apostles, who felt for him an attachment of *personal* friendship which we cannot feel, and which must have been much more tender and ardent than can warm our hearts towards Him, "whom, having not seen, we love." But there are circumstances attending this glorious event, in which all true Christians are equally interested, and from which they may all equally derive unspeakable comfort and joy.

The assurance that Christ has ascended "to his Father and our Father, to his God and our God," adds confidence to our faith. It is true that our faith, would, even without this event, have rested on the immoveable foundation of the promises of God, and the dying declaration of the Saviour, that all was finished. But there is something more satisfactory, and better suited to the imperfect state of our faculties, in the visible display which God has condescended to give of his love to Jesus, by publicly raising him from the dead, and opening the heavens to receive him. There are here substantial facts on which the mind can rest. The salvation of the world is no longer a matter of faith, but of vision. It is brought, as it were, within the evidence of the senses; and the testimony of men is made to concur with the declarations of God.

Another source of pleasure in the contemplation of Christ's ascension, is the belief that he is gone to appear

before the throne of God as our mediator and advocate. Men have, in all ages, looked for some intermediate step between themselves and their Creator; some being, less awful in the majesty of his attributes, and approaching nearer to a level with the weakness of humanity, who might lend a favourable ear to their petitions, and, presenting himself before the throne of the Eternal in their behalf, might insure an answer of peace. Hence, into the idolatrous worship of antiquity was introduced that host of deified men, and subordinate divinities, whose temples were decorated with more profuse magnificence than those of the Supreme God, and whose altars smoked with more numerous and costly victims. What, in the fondness of their hearts, the blind imaginations of the heathen only superstitiously conceived, the religion of Jesus has in reality provided. Our "Great High Priest is passed into the heavens," and "is seated at the right hand of God." Through him we are directed to make our wants known at the throne of grace; and we are assured that whatsoever we shall ask the Father in his name, he will be ready to grant. Nay, further, for the unspeakable comfort of those humble and contrite spirits whose hearts are broken under a sense of guilt, we are informed that, "If any man sin he has an advocate with the Father, Jesus Christ the righteous, and he is a propitiation for our sins; and not for ours only, but also for the sins of the whole world."

For an office so important and so endearing, the Son of Man is indeed eminently qualified. He partakes of our nature, and therefore knows our weaknesses, and the force of our temptations; he has suffered, and will therefore sympathize in our distresses. But, in contemplating Jesus as his intercessor and advocate, the circumstance on which the Christian rests with peculiar satisfaction, is the tender sensibility and compassion of his nature. I do not merely allude to that pity for the human race which induced the Son of God to assume the nature of man, and to become a man of sorrows,—though

this is much,—but chiefly to that tender and melting sympathy, which made him enter into the afflictions of others, and feel them as his own. There is an exquisite grace in this part of our Lord's character, which it is impossible to view without emotion. When we hear him comforting his disciples, we feel for him the affection of a friend,—when we see him tenderly soothing the mourning sisters of Lazarus, and mingling his tears with theirs, we love him as a brother; but when we observe him, in the agonies of the cross, praying for his murderers, there is an interest excited in our hearts which language has no words to describe. To the believer this sentiment is inexpressibly delightful and endearing, as he is taught to conclude, that this divine compassion is exercised towards himself. Jesus is "also touched with a feeling of our infirmities." He has carried with him into heaven all that love for the children of men which he displayed whilst on earth. Of all who believe in his name, there is not a single individual in whose welfare he does not feel a tender and affectionate interest. He takes a part in all our joys and sorrows. He makes use of that divine authority with which he is invested, to cause all things to work together for our good.

What an amiable view does this afford us of the Divine administration! How admirably is it calculated to interest the best affections of the heart in the cause of religion; to draw us by the cords of love to the service of the Redeemer; and to give new energy to our faith, boldness to our hope, and relish to our enjoyments! "Wherefore, holy brethren," says Paul, "partakers of the heavenly calling, consider the apostle and high priest of your profession, Christ Jesus; and come boldly unto the throne of grace, that you may obtain mercy, and find grace to help in the time of need"

NINTH WEEK—MONDAY.

BIRDS.—THEIR GREGARIOUS HABITS.

One of the most remarkable instincts of the lower animals, is that which induces them to congregate together for some mutual object; and this propensity is attended with other instinctive habits, which seem necessary for giving the arrangement full effect in producing the intended object. The gregarious habits of the ant and the bee among insects, have long been a subject of admiration; and although in no case do we find these habits so perfect among the higher orders of the inferior creation, yet neither among birds nor beasts are they altogether wanting.

I have already noticed the propensity of various species of birds to congregate during the breeding season, and for the purpose of migration. But there are other occasions in which there is obviously a mutual understanding among various families of the feathered tribes, and a banding together for objects of reciprocal advantage. The chief inducement to this social disposition, appears to be to guard against common dangers. It would seem that many of the smaller birds are more timid when solitary, than when in the company of their kind; and that some sort of sympathetic feeling is diffused through a flock, which, while it probably affords a social pleasure, increases in each a sense of mutual security. This may certainly be the case, even although they do not combine to defend themselves against a common enemy. It is well known, that various species of birds, when they feed in company, have watchers or sentinels placed on some elevated situation, to give them warning on the approach of danger. When a flock of sparrows, for example, alight in the corner of a wheat field, we may always be certain of discovering one, or perhaps several, perched on some high spray in the adjoining

hedge-row, prying into the probable design of every movement among men or animals, which lies within observation. The instant the sentinel perceives any thing which he deems worthy of notice, he gives his well-known signal, at which the whole flock hurry off from the banquet with the utmost celerity and trepidation. These fears are for the most part only momentary; for, as soon as the birds ascertain that there is no immediate danger, they hasten back to finish their meal, or light on some other part of the field, where they again feed under the protection of their sentinels.

"From all that we have been able to observe," says Mr Rennie, "there does not seem to be any thing like election or appointment of such sentinels. The fact appears rather to be, that, probably from being less impelled by the calls of hunger, the bird of the flock who chances to be the last in adventuring to alight, feels then reluctant to join his companions, in consequence of an instinctive foresight that they might all be thence exposed to danger." Whatever truth there may be in this, the paternal intention of the Creator in implanting the instinct is sufficiently conspicuous.

Rooks seem to be more particular even than sparrows, in having sentinels while they are feeding in parties after the breeding season. These rook-sentinels are so vigilant, that it is by no means easy to get within shot of a foraging party; and hence it is popularly believed that rooks can smell gunpowder. Although this is a mistake, they do appear to have some knowledge of the danger arising from fire-arms, as any one may prove by levelling a walking-cane at a flock, when they will instantly fly off in great alarm. Such knowledge must be derived from experience. In confirmation of this, it is stated in some accounts of newly discovered countries, that the birds were not at first frightened by the presenting of a fowling-piece, but soon became so after some experience of its effects.

The golden plover and the crane seem each to have a

kind of king or leader, whom the whole flock obey. The latter class Aristotle places at the head of gregarious birds; and Pliny says, that their sentinels "stand on one foot, and hold a little stone within the other, which, by falling from it, if they should chance to sleep, might awaken them and reprove them for their negligence." We are not obliged to believe this, although the historian Ammianus Marcellinus informs us, that, in imitation of their ingenuity, Alexander the Great was accustomed to rest a silver ball in his hand, suspended over a brass bason, which, if he began to doze, might, by falling, give an alarm, and preserve his vigilance.*

We do not often find instances among birds of mutual assistance, afforded in carrying on a common work, such as is frequently met with among insects, and sometimes, but much more rarely, among quadrupeds, of which latter instinct the beaver is a memorable example. But besides the instance of the grosbeaks of Africa, which are said to unite their labours in building their nests, there are some well-attested cases of an occasional union of birds of the same species, to effect a special purpose. That of swallows to entomb a robber sparrow in an usurped nest, has already been mentioned.†

M. Dupont de Nemours gives another instance of the social instinct of the swallow exerting itself in a singular way, which fell under his own observation. The following is his account:—"I remarked a swallow which had unhappily,—and I cannot imagine in what manner,—slipped its foot into a slip-knot of packthread, the other end of which was attached to a spout of the Col-

* Apud Aldrovandi Ornith. vol. iii. p. 137.

† "Spring."—Article, Nests of Swallows.—Such a feat has been confidently rejected by Mr Rennie as imaginary, on the ground of "the impossibility of so entombing by means of clay, a bird with so powerful a bill as a sparrow."—*Habits of Birds*, p. 55. A sufficient answer to this theoretical objection may be given in the words of a character in the Castle Spectre,—"I did not say it was *possible*. I only said it was *true*." The bird is probably on such occasions terrified at its unusual situation, and so stupified as not to be aware that it could by its own exertions extricate itself.

lege of the Four Nations. Its strength was exhausted; it hung at the end of the thread; uttered cries, and sometimes raised itself, as if making an effort to fly away. All the swallows of the large basin between the bridges of the Tuilleries and the Pont Neuf, and perhaps from places more remote, had assembled, to the number of several thousands. Their flight was like a cloud; all uttered a cry of pity and alarm. After some hesitation, and a tumultuous council, one of them fell upon a device for delivering their companion, communicated it to the rest, and began to put it into execution. Each took his place; *all* those who were at hand went in turn, as in the sport of running at a ring, and, in passing, struck the thread with their bills. These efforts, directed to one point, were continued every second, and even more frequently. Half an hour was passed in this kind of labour before the thread was severed, and the captive restored to liberty. But the flock, only a little diminished, remained until night, chattering continually in a tone which no longer betrayed anxiety, and as if making mutual felicitations and recitals of their achievements." *

NINTH WEEK—TUESDAY.

DOMESTIC FOWLS.—THE COCK, THE TURKEY, AND THE PEACOCK.

HAVING already given an account of some of the more remarkable faculties and habits of birds, I shall only select one or two species for particular description; and that which claims our first notice, on account of its use-

* *Antoine, Animaux célebres*, vol. ii. App. p. 18.—Mr Rennie, with unnecessary scepticism, also doubts the accuracy of this narrative. There may probably be in it some characteristic painting; but the leading fact is very analogous to that of building up the sparrow, and may be equally credited, notwithstanding its singularity.

fulness to the human family, is the tribe of domestic fowls, in its different varieties. This species of birds is connected with a class, all of which seem to be intended for the special use of man, being of white and delicate flesh, and having short and concave wings, which prevent them from making long flights, and confine them much to the same locality; while they are quite harmless, and most of them easily tamed. Among these we may rank the common cock, the peacock, the turkey, the Guinea-hen, the pheasant, the bustard, the grouse, the partridge, and the quail. To the four first only the title of domestic fowl applies. They all bear a strong similitude to each other, being all granivorous, and equally delicate to the palate. They are, among birds, what beasts of pasture are among quadrupeds, peaceable tenants of the field, shunning the thicker parts of the forest, where they would encounter numerous animals which would mark them for their prey.

The various kinds of domestic fowl are gregarious both in their wild and tame state. The most courageous male conquers for himself a seraglio of female dependants, who willingly live under his sway, although they seem to have no exclusive preference for him; and if he be finally subdued in the combat, his rival takes undisputed possession both of the locality in which he moved, and of his wives, while he sinks into unpitied insignificance. Hence the proverbial courage of the dunghill cock. He fights for all that gives relish to his existence.

The power of domestication, in causing alterations not only in the habits, but in the appearance and form of animals, is no where more strongly exemplified than in the cock. He seems to be, of all the birds, the oldest companion of man, having been, in very early ages, reclaimed from the forest, and taken to supply the accidental failure of the chase. It is probably on this account that he exhibits such interminable varieties in plumage and in form. "The tail," says Goldsmith,

"which makes such a beautiful figure in the generality of these birds, is yet found entirely wanting in others; and not only the tail, but the rump also. The toes, which are usually four in all animals of the poultry kind, yet in a species of the cock, are found to amount to five. The feathers, which lie so sleek, and in such beautiful order in most of those we are acquainted with, are, in a peculiar breed, all inverted, and stand staring the wrong way. Nay, there is a species, that comes from Japan, which, instead of feathers, seems to be covered all over with hair. These, and many other varieties, are to be found in this animal, which seem to be the marks this early prisoner bears of his long captivity."*

The cock seems first to have been introduced into Europe from Persia, as Aristophanes calls it the *Persian bird;* but it is no longer found wild in that country. It is only in some of the islands of the Indian Ocean, and along the Malabar coast, that this animal is known to exist in its ancient state of independence. In his wild condition the plumage of the cock is black and yellow, and his comb and wattles yellow and purple. In the Indian species there is another peculiarity. Their bones, which with us are white, are, in this kind, as black as ebony, arising probably from some quality in their food; which may be conjectured from the well-known fact, that the bones of fowls fed on madder are tinctured red.

The turkey is the kind of poultry next in repute as a domesticated fowl. It is a native of America, where it is still found in abundance in the woods, and where it is much larger, and more beautiful than in its state of domestic captivity. There their feathers are of a dark grey, bordered at the edges with a bright gold colour. It was transported to Europe immediately after the conquest of Mexico, and was first introduced into England, during the reign of Henry VIII.

* Goldsmith's "Animated Nature,"—Article, the Cock.

The habits of this bird, in a state of nature, are singular. To some of these I have elsewhere adverted, in speaking of their reproductive instincts.* They are gregarious, and seldom mount on the wing, unless forced by pursuit, or when it is necessary to cross a river, in their migrations in search of food. In the latter case, their mode of operation is worthy of being recorded. When they find their progress interrupted by a river, they stop short for a day or two, as if for the purpose of consultation. During this time, the males are heard gobbling and calling, and are seen strutting about apparently full of important business. Even the females and the young seem to partake of the excitement, spreading out their tails, taking extravagant leaps, and running round each other with a loud *purring* noise. At length the whole party mounts to the tops of the highest trees, whence, at a signal, consisting of a single *cluck*, given by a leader, the flock takes flight for the opposite shore. The old and fat birds easily get over, even though the river be a mile in breadth; but the younger and less robust, frequently fall into the water, not, however, to perish; for here an instinct is bestowed on them, suited to the emergency. They bring their wings close to their body, spread out their tail as a support, stretch forward their neck, and, striking out their legs with great vigour, proceed rapidly towards the shore. When they reach the opposite bank, should they find it too steep for landing, they cease their exertions, and allow themselves to be floated down the stream, till they reach an accessible part, when, by a violent effort, they extricate themselves from the water. The turkey is said to be a stupid animal; and certainly some of its actions indicate little forethought or contrivance; but, in these particulars, the instinct of self-preservation, impressed on them by their Maker, is powerful and ingenious.

The following account is given by Goldsmith, of the manner of hunting this bird, in its wild state, among the

* "Spring, pp. 192, 193. Third Edition.

savage tribes of its native country :—" When the hunter has discovered the retreat of a flock, which is generally near fields of nettles, or where there is plenty of any kind of grain, he takes his dog with him, which is trained to the sport (a faithful rough creature, supposed to be originally reclaimed from the wolf), and sends him into the midst of them. The turkeys no sooner perceive their enemy, then they set off, running at full speed, and with such swiftness, that they leave the dog far behind them. He follows nevertheless; and, sensible that they must soon be tired, as they cannot go full speed for any length of time, he at last forces them to take shelter in a tree, where they sit, quite spent and fatigued, till the hunter comes up, and, with a long pole, knocks them down, one after the other."

In illustration of the power already adverted to, which birds possess, of marking their enemies at a distance, and of making their meaning known by the sounds they utter, I may quote the following interesting account of the Abbé de la Pluche :—" I have heard a turkey-hen," says he, " when at the head of her brood, send forth the most hideous screams, without knowing, as yet, the cause; however, her young, as soon as the warning was given, skulked under the bushes, the grass, or whatever else offered for shelter or protection. They even stretched themselves, at full length, upon the ground, and continued lying as motionless as if they were dead. In the mean time, the mother, with her eyes directed upwards, continued her cries and screaming as before. Upon looking up to where she seemed to gaze, I discovered a black spot just under the clouds, but was unable at first to determine what it was; however, it soon appeared to be a bird of prey, though, at first, at too great a distance to be distinguished. I have seen one of these animals continue in this violently agitated state, and her whole brood pinned down, as it were, to the ground, for four hours together; whilst their formidable foe has taken his circuits, has mounted, and hovered directly over their heads.

At last, upon his disappearing, the parent began to change her note, and sent forth another cry, which, in an instant, gave life to the whole trembling tribe, and they all flocked round her, with expressions of pleasure, as if conscious of their happy escape from danger."

There are probably other gallinaceous birds, besides the turkey, found in America, which might be advantageously domesticated in Europe, among which the curassows have been particularized. This tribe can be tamed with the greatest ease, and is held in high estimation in many parts of South America.

Of the peacock, it is not necessary to say more than that it is at once the most beautiful in plumage, and the harshest in voice of any of the feathered tribes taken under the protection of man; and its insatiable gluttony, and spirit of depredation, make it at the same time, the most troublesome of the domestic birds. The Italians have an appropriate aphorism characterizing it as possessing the plumage of an angel, the voice of a fiend, and the stomach of a thief.

NINTH WEEK—WEDNESDAY.

DOMESTIC FOWLS.—THE GOOSE AND THE DUCK.

Besides different species of the poultry class, already mentioned, men have domesticated two kinds of waterfowl, the goose and the duck. They are each esteemed as food, and the former is also of great value, both on account of the quills which it yields for writing, and of the feathers, which are employed so universally among civilized nations, as a soft and comfortable bed. The habits of the domestic goose are well known; but its dull appearance, and the cackling sound it emits, when disturbed, have procured for it a character for stupidity which it does not deserve; while a single incident, perhaps fabulous, has stamped it with a character for vigi-

lance which seems equally exaggerated in another direction. A few remarks will serve to correct both of these popular notions.

With regard to extreme vigilance, the story of a flock of geese having saved the Roman capitol, is well known to every scholar. This story has induced some to attribute to the goose great acuteness of hearing, and others to allege that, by the smell, it "scents the odour of man at a great distance." Both of these opinions are now believed to be fallacious; and, if the account be any thing better than a legend, the fortunate vigilance of the geese on the occasion alluded to, must have been owing, as Albertus Magnus has remarked, to the lightness with which they are known to sleep, which causes them to be awakened by the slightest noise.

That the goose is not so stupid an animal as is generally supposed, may be inferred from many facts. The anecdote elsewhere mentioned, of the gander which roused the family when a polecat had attacked his mate on her nest, is a case in point.* The following account, which is given on the authority of the respectable individual who was the object of the animal's attachment, shows that the goose is possessed of both warm affections, and considerable sagacity. A bird of this species, whose name was *Jacquot*, had been kindly treated and liberally fed by the narrator; and, one day on going from home, this gentleman had passed through the barn-yard, and noticed his favourite gander as usual. The narrative thus proceeds:—"He no sooner saw himself separated from me, than he vented strange cries. However, I went on my road, and had advanced about a third of the distance, when the noise of a heavy flight made me turn my head, and I saw Jacquot only a few paces from me. He followed me all the way, partly on foot, and partly on the wing, getting before me, and stopping at the cross-paths, to see which road I intended taking. Our journey lasted from ten in the morning to eight in the evening, and

* "Spring." Article "Parental Affection." Note.

my companion followed me through all the windings of the wood, without seeming to be tired. After this he attended me every where, so as to become troublesome; for I was not able to go to any place without his tracing my steps; so that, one day, he even came to find me in the church. Another time, as he was passing by the rector's window, he heard me talking in the room; and, as he found the door open, he entered, climbed the stairs, and marching in, gave a loud exclamation of joy, to the no small affright of the family." The sequel of the story is distressing. His attachment became so inconvenient, that it was necessary to shut him up, which caused him to pine. His inquietude lasted about a year, when he died of vexation.

Wilson mentions the case of a wild goose, which, having been wounded, and taken alive, by a Mr Platt, a farmer on Long Island, was placed among his tame geese, and soon became quite familiar. One day, however, in the following spring, the goose hearing the bugle-note of the leader of a flock, as they passed over the barn-yard, in their annual migration to the northern regions, "spread its wings, mounted into the air, and was soon out of sight." In the succeeding autumn, Mr Platt happened to be standing in his barn-yard, when a flock of these wild geese, on their return to the south, passed over his head. "At that instant, he observed three geese detach themselves from the rest; and, after wheeling round several times, alight in the middle of the yard. Imagine his surprise and pleasure, when, by certain well remembered marks, he recognized, in one of the three, his long lost fugitive." She had hatched and reared her offspring in the distant lakes of the north, "and had now returned, with her little family, to share the sweets of civilized life."

A similar anecdote of the tame goose was frequently related, in my hearing, by a neighbouring clergyman, of unquestionable veracity, now dead.* His parish was

* The late Dr M'Morine of Carlaverock.

bounded, on one side, like my own, by the Solway Frith; and a flock of geese from the opposite county of Cumberland, where they are reared on extensive commons, having, by some accident, crossed over to the Scottish side, enticed a solitary pair, belonging to my friend, to elope with them. They were given over for lost; but, about the end of autumn, he was astonished to observe the arrival of a considerable flock at his barn-door. He quickly recognized, in the leaders of the flock, the pair which had deserted him in the preceding spring. The rest, amounting to eight or ten young ones, full-fledged, and well grown, he did not doubt were the progeny of the truant birds, in the summer residence they had chosen for themselves.

The flight of wild geese is very remarkable, and shows, if not a wisdom of their own, at all events an implanted instinct which indicates a practical knowledge of the principles of aërostation. They place themselves in two oblique lines, forming an angle, or in a single line, where the flock is not very numerous. The bird that is at the head of the angle, or the line, and thus cuts the air first, retires, when fatigued, to repose himself in the last rank, and the others take his place in their turns. There is a marked combination and intelligence in this arrangement; for it is the most favourable for each individual, and enables the entire flock to glide through the air with the least fatigue.

The duck is of another aquatic species, and has habits peculiar to itself. In conformation it differs from the goose, in various particulars sufficiently marked; among which are, a smaller body, less extended wings, a shorter neck, a bill slenderer at the base, and thicker towards the tip, and legs placed farther back on the body. In many points, however, these two classes agree, and indeed have a nearer affinity than usually belongs to different species in other departments. The alterations produced on them by their domestic habits, in a long series of ages, have caused the goose and the duck to

differ as much from the wild sorts of their own species, as, in some of the kinds, they differ from each other. Of both, the most obvious distinction from the other feathered tribes, lies in the bill, which is broad and flat, being intended for shovelling up their food, and is sheathed with a skin which covers them all over.

There are considerable varieties among the duck species, ten different sorts of the tame kind being enumerated, and more than twenty of the wild. They may, however, be separated into two groups, the one distinguished by having the thumb or great toe bordered by a membrane, the other by the want of this appendage, while they are smaller in the head, longer in the legs, and altogether more graceful and more active.

The most celebrated of the wild species is the eider-duck, which is found in great abundance in the north of Europe and America. In Norway, where it particularly abounds, the natives have cruelly converted one of the most interesting of instincts, into a means of gratifying their cupidity. It is well known that the maternal solicitude of the eider-duck leads her to line her nest with the down plucked off her own breast, which is in great request on account of its beauty and warmth. When the inhabitants find one of these nests, they carefully collect and remove the down and eggs. The bird soon lays again, and covers the eggs with fresh down, which she again plucks from her breast. When she has repeated this operation, three several times, she has exhausted the supply from her body; and it is said that the male bird then comes to her assistance, and covers the eggs with down from his own breast. Half a pound weight of down may thus be collected from a single nest, during the breeding season, which is of such extraordinary elasticity, that three quarters of an ounce will fill a large hat. It is indeed at once the softest, the warmest, and the lightest substance with which we are acquainted.

It is curious to see similar instincts occurring in or-

ders far apart from each other. The gipsey-moth and the rabbit, both in a similar manner, line their nests with down plucked from their bodies, affording remarkable instances of the analogies which are found every where meeting and surprising the inquirer into nature.

NINTH WEEK—THURSDAY.

BIRDS OF PREY.—THE VULTURE.

PASSING over all the other species of the feathered family, each of which has its use in the economy of nature, I shall conclude this section of my work, by noticing two orders of birds, in some respects nearly allied to each other, yet each occupying its own distinct position, and fulfilling its own peculiar intention; I allude to the vulture and the falcon tribes, the one designed to devour animals already dead and undergoing the process of decay, the other to preserve within due bounds the animated creation, by taking living creatures for its prey. Of both of these classes there are many varieties, suited to different localities and different climates. As types of the whole of these classes, I shall select one or two examples of each.

I begin with the vulture, and of this genus the American condor first presents itself as appropriate on account of its superior size. The immense mountain chain which runs down the continent of South America, is the native stronghold, where these birds dwell in security. In Peru and Chili, they are even abundant, but are seldom seen in flocks of more than three or four together. There, in the regions of perpetual snow and terrific storms, 15,000 feet above the level of the sea, on some isolated pinnacle, some horrid crag, the condor rears its brood, and looks down with piercing eye upon the plains beneath, yet far away, for food. Like the rest of its family, it feeds on carrion, and gorges itself to disgust-

ing repletion, so as to become incapable of flight. In this state it is often captured; and the Indians are accustomed to expose the dead body of a cow or a horse, so as to attract the notice of these birds, as they are seen sailing in the sky. Down they sweep, and glut themselves with the luxurious banquet, when the Indians appear with their lassos,* throw them with unerring certainty, and gallop away, dragging after them the ensnared victims. These gigantic birds, which are in length between three and four feet, and from nine to ten in expanse of their wings, are by no means formidable; they are not ferocious, and their talons, not being intended to seize living prey, are too feeble to lacerate. The natives do not fear them, and are accustomed, with their children, to sleep near their resort, exposed to attack, were this ever to be apprehended. Of the strength of the condor, and its tenacity of life, we have many authentic accounts. Captain Head relates an attempt of one of his Cornish miners to overcome one of these animals gorged with food, when, after a severe struggle of an hour, the man was obliged to leave his victory incomplete. Humboldt mentions the particulars of a cruel experiment made by some Indians in his presence, to show the strength of the condor's vital powers. It was hanged by the neck on a tree for several minutes, and pulled forcibly by the feet, yet, when released, it rose and walked about as if nothing had occurred to affect it. It was then shot at with a pistol within four paces, and it was not till the fourth ball struck its thigh, that it was brought to the ground; nor did it die of its wounds till after an interval of half an hour.

While sailing at ease in the air, the condor exhibits a noble spectacle of grace and majesty, which cannot be regarded without admiration. To see him with expanded wings, wheeling round the topmost summits of

* The lasso is a cord with a slip loop, which the natives use with great dexterity on horseback, in seizing the wild cattle and horses which abound in South America.

the Andes, or sweeping down in a series of gyrations from the upper sky, each circle contracting as the earth is neared, is represented by travellers as a sublime and imposing sight.*

The vulture is found in most parts of Europe, where it pursues its useful office of destroying dead carcasses; but it is chiefly numerous in the warmer regions of the earth, where decomposition goes on rapidly, and the noxious effluvia arising from decaying animal substances might, without the interference of this bird, be both annoying and destructive. In Egypt, the vulture is of singular service. There are great flocks of them in the neighbourhood of Grand Cairo, which no person is permitted to destroy. The service which they render the inhabitants is the devouring all the carrion and filth of that great city. "They are commonly seen," says Goldsmith, "in company with the wild dogs of the country, tearing a carcass very deliberately together. This odd association produces no quarrels; the birds and quadrupeds seem to live amicably, and nothing but harmony subsists between them. The wonder is still the greater, as both are extremely rapacious, and both lean and bony to a very great degree, probably having no great plenty, even of the wretched food on which they subsist."†

The vulture may be justly called the scavenger among the winged tribes. For this important, though ignoble, department, it is admirably fitted by Nature. Its far-seeing eye, its powerful wing, its rapacious appetite, its decided preference for carrion, all mark it out as appointed to this special office by the fiat of its Maker. It fulfils its appointed duty with wonderful efficiency. Of one species, the griffon, which is widely diffused, it is said by a celebrated naturalist, that "when once it has made a lodgement on its prey, it rarely quits the banquet while a morsel of flesh remains, so that it is not

* "Introduction to the Study of Birds," p. 24, 25.
† Animated Nature,—article Vulture.

uncommon to see it perched upon a putrefying corpse for several successive days." Of another, which inhabits the south of Africa, Kolben says, "I have been often a spectator of the manner in which they have anatomized a dead body; I say anatomized, for no artist in the world could have done it more cleanly. They have a wonderful method of separating the flesh from the bones, and yet leaving the skin quite entire." Of all the different kinds, it may be said in general, that nature has bestowed upon them a most voracious and almost insatiable desire to devour, under different habits suited to their respective localities.

There is in this genus a remarkable instance of the tendency in nature, already noticed, of one group of animals to pass insensibly, and by intervening forms and instincts, into another. I allude to the lämmergayer, or bearded vulture, a species nearly allied in many particulars to the eagle family, and yet possessing too many characteristics of the class we have been considering to suffer us to mistake its true place among the winged tribes. This bird emulates the eagle in its daring and rapacious habits. "Sailing in the air above the snow-clad summits of the stupendous Alps," says the author of a recent publication, "it watches until the unwary chamois approaches the edge of a precipice, or traverses the pass of a narrow ledge, and then, sudden and impetuous as the avalanche of its native regions, down it rushes, hurling the helpless animal into the abyss below, when, proudly whirling round for a few gyrations, as if to contemplate the effects of its sanguinary deed, it plunges down to gorge on the yet quivering flesh." Bruce, in his "Travels," gives a remarkable instance of the boldness and voracity of this bird. His servants were preparing dinner on the summit of a lofty mountain, when a bearded vulture slowly advanced, and at length fairly seated himself within the ring which they had formed. The affrighted natives started up, and ran for their lances and shields; and the bird, after an in-

effectual attempt to extract a portion of their meat from the boiling water, seized a large piece in each of his talons from a platter that stood by, and carried them off slowly along the ground as he came. After an interval of a few minutes, the vulture returned for a second freight, but was shot by the traveller before it could carry its purpose into effect.

NINTH WEEK—FRIDAY.

BIRDS OF PREY.—THE EAGLE.

The eagle, which, like the lion among quadrupeds, is the acknowledged king of that division of nature to which it belongs, is ranked among the order of falcons. The following spirited description of it is given by a recent writer on the natural history of birds:—"They live by slaughter; they carry on a war of ruthless extermination, and surround their lonely nests with the relics of many a bloody feast. Their port is free and noble, their eyes piercing, their body firm and compact, their flight rapid and impetuous, their beak and talons are hooked, sharp, and formidable. They live alone or in pairs; some on the cliffs of the sea-shore, some on the highest mountains, some among the secluded recesses of the woods, and some on wide heaths and moors. All are busy and active in the destruction of life. Some, perched on a rocky height, or on the topmost branches of a tree, mark their prey at a distance, and rapid as an arrow, launch upon the fated quarry; some skim our fields and woods, and pounce sudden and silently on the unsuspecting victim; they soar aloft, and sweep down like a thunderbolt upon their prey while in the air; or glide upon it obliquely, and thus skim it from the surface of the earth. All, however, are not of equal courage; some attack birds and quadrupeds larger than themselves, and capable of making resistance; others

content themselves with feeble animals, lizards, snakes, frogs, mice, and the like. The females exceed the males in size and powers."*

From this numerous and diversified class, I select the white-headed eagle of America, which is emblazoned on the national standard of the United States, and is spread nearly over the whole northern division of the New World. I do this for two reasons; first, because it is one of the most powerful of the eagle family, and furnishes in itself an example of a bird which feeds on prey both from the land and waters; and, secondly, that I may have an opportunity of introducing the graphic and spirited description of two eminent and eloquent naturalists, who bring, as it were, before our very eyes this tyrant and scourge of the inferior creation. The following is Audubon's account of the royal bird's manner of capturing the wild swan:—

"To give you some idea of the nature of this bird, permit me to place you on the Mississipi, on which you may float gently along, while approaching winter brings millions of waterfowl, on whistling wings, from the countries of the north, to seek a milder climate in which to sojourn for a season. The eagle is seen perched in an erect attitude on the highest summit of the tallest tree, by the margin of the broad stream. His glistening but stern eye looks over the vast expanse; he listens attentively to every sound which comes to his quick ear from afar, glancing now and then on the earth beneath, lest even the light tread of the fawn may pass unheard. His mate is perched on the opposite side, and, should all be tranquil and silent, warns him by a cry to continue patient. At this well known call the male partly opens his broad wings, inclines his body a little downwards, and answers to her voice in tones not unlike the laugh of a maniac. The next moment he resumes his erect attitude, and again all around is silent. Ducks of many species, the teal, the widgeon, the mallard, and others,

* Study of Birds, p. 35, 36.

are seen passing with great rapidity, and following the course of the current, but the eagle heeds them not. They are at that time beneath his attention. The next moment, however, the wild, trumpet-like sound of a yet distant, but approaching swan, is heard. A shriek from the female eagle comes across the stream; for, kind reader, she is fully as alert as her mate. The latter suddenly shakes the whole of his body, and, with a few touches of his bill, aided by the action of his cuticular muscles, arranges his plumage in an instant. The snow-white bird is now in sight; her long neck is stretched forward; her eye is on the watch, vigilant as that of her enemy; her large wings seem with difficulty to support the weight of her body, although they flap incessantly. So irksome do her exertions seem, that her very legs are spread behind her tail to aid her flight. She approaches, however. The eagle has marked her for his prey. As the swan is passing the dreaded pair, the male bird starts from his perch, in full preparation for the chase, with an awful scream, that, to the swan's ear brings more terror than the report of the large duck-gun. Now is the moment to witness the eagle's powers. He glides through the air like a falling star; and like a flash of lightning comes upon the timorous quarry; which now, in agony and despair, seeks, by various manœuvres, to elude the grasp of his cruel talons; she mounts, doubles, and willingly would plunge into the stream, were she not prevented by the eagle, which, long possessed of the knowledge, that by such a stratagem the swan might escape him, forces her to remain in the air, by attempting to strike her with his talons from beneath. The hope of escape is soon given up by the swan. She has already become much weakened, and her strength fails at the sight of the courage and swiftness of her antagonist. Her last gasp is about to escape; when the ferocious eagle strikes with his talons the under side of her wing, and, with resistless power, forces the bird to fall in a slanting direction upon the nearest shore. It is

then, reader, that you may see the cruel spirit of this dreaded enemy of the feathered race, whilst, exulting over his prey, he for the first time breathes at ease. He presses down his powerful feet, and drives his sharp claws deeper than ever into the heart of the dying swan. He shrieks with delight as he feels the last convulsions of his prey, which has now sunk under his unceasing efforts to render death as painfully felt as it can possibly be.* The female has watched every movement of her mate, and if she did not assist him in capturing the swan, it was not from want of will, but merely because she felt full assurance that the power and courage of her lord were quite sufficient for the deed. She now sails to the spot, where he eagerly awaits her, and, when she has arrived, they together turn the breast of the luckless swan upwards, and gorge themselves with gore."

Wilson is not less happy in his description of the manner in which the white-headed eagle obtains a repast of fish. He avails himself generally, it seems, of the labours of others, and especially of the osprey, or fish-hawk, which he forces to deliver up his prey. After describing the variety of the feathered tribes within the view of the eagle, as he sits "elevated on the high dead limb of some gigantic tree," the naturalist thus proceeds:—"High over all these hovers one whose action instantly arrests his attention. By his wide curvature of wing, and sudden suspension in the air, he knows him to be the fish-hawk, settling over some devoted victim of the deep. His eye kindles at the sight, and balancing himself with half-opened wings on the branch, he watches the result. Down, rapid as an arrow, from heaven descends the object of his attention, the roar of its wings reaching the ear, as it disappears in the deep, making the surges foam around. At this moment the

* We may be allowed to doubt the truth of the expression in the last clause of this sentence, which seems inserted for effect. So far from the victim being subjected to unnecessary torture, there is a remarkable instinct given to animals of prey, by which they know how to dispatch their quarry with as little pain as possible, and this they in general practically effect.

eager looks of the eagle are all ardour; and levelling his neck for flight, he sees the fish-hawk once more emerge, struggling with his prey, and mounting in the air with screams of exultation. These are the signals for our hero, who, launching into the air, instantly gives chase, and soon gains on the fish-hawk. Each exerts his utmost to mount above the other, displaying in these rencounters the most elegant and sublime aerial evolutions. The unencumbered eagle rapidly advances, and is just on the point of reaching his opponent, when, with a sudden scream, probably of despair and honest execration, the latter drops his fish. The eagle, poising himself for a moment, as if to take more certain aim, descends like a whirlwind, snatches it in its grasp ere it reaches the water, and bears his ill-gotten booty silently away to the woods."

NINTH WEEK—SATURDAY.

PREDACEOUS ANIMALS.—THEIR OFFICES IN NATURE.

I HAVE already more than once adverted to the remarkable, and, in some respects, mysterious arrangement, by which certain animals are formed, to deprive other living creatures of their existence, and gorge themselves with their remains.* This is a subject, however, which, in reference to the moral character of the Creator, is of very grave importance, and requires deliberate consideration. The predaceous habits of the eagle tribe, which we have just been contemplating, furnish a proper opportunity for the discussion. I do not doubt that the system of prey can be shown to be a benevolent provision, suited with consummate wisdom to the other conditions of our fallen world.

In arguing this subject, it is especially necessary to

* See particularly "Winter,"—paper on the Balance preserved in the Animal and Vegetable Creation.

keep in mind what was said in the commencement of the "Winter" volume, regarding the character impressed on Nature, which does not exhibit a system such as might be formed by a philosopher in his closet, where evil is excluded, and moral perfection and unalloyed happiness universally prevails; but a scheme of compensations and contrivances, by which "evils are averted or mitigated, and excellence is drawn from the very bosom of apparent defect and worthlessness."* This is just what we might expect to discover in a world of discipline, for such a rational but sinful creature as man. It is what, in every part of our inquiry, we have found actually to exist.

The first question connected with the subject I am now discussing, is the general one of the existence of pain. With Sir Charles Bell's admirable exposition of the sensibility of the surface, compared with the deeper parts of the body, the reader is already acquainted;† and nothing further is necessary to show in this instance, that pain, so far from being an unmitigated evil, is given for benevolent purposes, is obviously modified and limited so as best to promote these purposes, and, in the advantages which it confers, unspeakably counterbalances any distress which it may occasion. But this is only an example, though a striking one, of a principle which every where discovers itself to the judicious inquirer, and forms a peculiar characteristic of the providential arrangements in the animal world.

There is another view of this subject, which has not been considered with the attention it demands, but which would amply repay the inquirer into Nature, I mean the comparative degree of sensibility to pain existing in different orders of beings. Dr Macculloch has turned his mind to this subject, and has brought forward many convincing reasons to show that we are mistaken if we judge of the pain suffered by the inferior creation, from

* See "Winter,"—papers on the Characters impressed on Nature.

† "Winter,"—paper on Contrivance.

the acuteness of our own corporeal feelings;—that, in fact, the sensibilities of all the lower animals seem to be inferior to that of man, while they exist in very different degrees in different orders; and that these sensibilities have been so regulated as "to permit them to perform their functions, and enjoy their lives, with the least superfluous pain, or contingency of pain."

This is an important point obtained, in commencing the consideration of the system of prey; for if it can be shown that this system secures a far greater extent and variety of animal existence, than on any other conceivable plan, consistent with other cosmical arrangements, was at all possible, and at the same time that the enjoyment of life greatly countervails the suffering, the scheme will at once appear to be benevolent; while the obtuseness of feeling in those animals which suffer a violent death under this system, serves still further to abate the evils with which it is confessedly attended.

The power of subsistence in animals depends on the quantity of their food. The design of the Creator, therefore, being to extend happiness by extending animal life, one necessary part of this intention must be to produce the greatest possible quantity of food. Now, although it be true, that the primary means of subsistence are placed in the vegetable world; yet, if animals were merely constituted so as to consume plants and their produce, it cannot be doubted, not only that the various tribes of animals would be greatly diminished, but that the entire mass of life would be very much reduced, and many portions of nature would remain untenanted. If we look at the ocean, for example, this will appear in a very striking light. Vegetable productions could not, consistently with known material laws, have been produced in the sea, in sufficient quantity to supply marine animals with food, to the extent in which they actually exist. Let any person reflect on the number of fishes, "the myriads of shell-fishes, the still more unaccountable myriads of the inferior tribes, down to the coral-

making animals, and even, beyond all this, the incomprehensible crowds, which, in a constant series of gradations downwards, both in structure and magnitude, at length escape our microscopes," and he will easily perceive that, but for the predaceous habits of the inhabitants of that element, it would have been impossible that the same quantity of life could be sustained.

The very same thing, though in a more limited degree, takes place among land animals. Now, it is allowed, that a considerable accession of food might have been obtained by bestowing on all living creatures the instinct which actually belongs to those animals that, like the vulture, feed on carrion. But this supply is necessarily limited and uncertain, and, without an alteration in the laws of decomposition, would always be transitory. The system of prey was therefore necessary, under present conditions, for the fulfilment of the benevolent intentions of the Creator.

In adverting to this system, it has been justly said, that, as respects the animals which are the victims of it, a natural death is generally attended with greater, and certainly more protracted pain, than a violent one; and, in the case of domestic animals, which are the prey of the human race, the care of man, in defending them from enemies, and providing for them an abundance of wholesome and agreeable food, is a further countervailing circumstance of no slight amount. It does not appear, however, that Paley has taken the most correct view of the subject, when he asserts that the system of prey is the natural and necessary remedy for "superfecundity," the converse of this proposition being more consistent with an enlarged and enlightened consideration of the subject, namely, that one of the intentions of what he terms super-fecundity, was to promote animal existence in all its various forms. "If," says Macculloch, "the cod produces six millions of progeny at once, it is because this food is assigned to other fishes as their provision: For any other purposes it would be an un-

wise appointment (which cannot be admitted), since even one fish would fill the entire ocean in a few years: And if, while the marine insects of the north are produced in endless millions, their devourer, the whale, produces but one in the same time, we must conclude that these crowds were destined for its food."

The system of prey, then, is a wise provision, intended not merely to preserve the balance of nature, as formerly stated, but to preserve that balance at the full extent of animal existence. The evil of a violent death, even were it tenfold greater than it is, could not counterbalance this good; and that evil has many mitigations. Not to recur to what has already been said as to the sudden nature of this kind of death, and the dullness among the inferior animals in their sensibility to pain, it must be remembered, that they are not tormented with anticipations of this calamity, nor is it aggravated by any knowledge of the fatal event awaiting them, even when in the very act of expiring under the fangs of their devourer.

There is another fact relating to this subject, which must not be omitted, as it is a singular and beautiful provision of Providence, for mitigating the pain of destruction. In the neck, near the skull, there is a point where a wound of the spinal marrow produces instant death, apparently without suffering; and it is not a little remarkable, that such effect is confined to a single and constant point. Now this point, though perfectly defended from all ordinary injuries, is accessible to a certain degree of violence, when that violence is skilfully applied. Dr Macculloch remarks, that the knowledge of this fact, which man has only discovered by experiment, has been given to all predatory animals from their birth; and if this is a needful security to them for procuring their food, it is still more a merciful provision for the suffering animal. "Every one knows," says he, "that this part of the spine is almost always the object of attack; while, if there are some animals which as instinctively seize on the carotid arteries, the design is of

the same nature, and both equally confirm the present views."

These considerations are, I think, sufficient to establish that there is both wise and benevolent contrivance in this system of prey; but I must not allow it to be thought that I have any wish to conceal the difficulties under which natural religion still labours, on the whole question, of which this is only a part. Let the mitigations be what they may, the question still remains behind, why evil should exist at all. It is obvious that this is intended; and yet we cannot conceive any reason which should render impossible the existence of a world without it. Such a world, indeed, would be entirely different from ours, both in its construction and in its ultimate object. It would not be a world of discipline. If we would understand the intentions of the Eternal, and fully vindicate his perfections, our knowledge must be derived from the higher science of revelation. It is there alone that we can understand why "the whole creation groaneth and travaileth in pain together until now."*

* Romans viii. 22.

TENTH WEEK—SUNDAY.

CHRIST, THE JUDGE OF THE WORLD.

THERE is an important doctrine connected with our Lord's ascension, which was not noticed in considering this subject in a previous paper, and to which I shall now direct the reader's attention. I allude to the office which he is appointed to execute as the Judge of the human race at the Last Day. This doctrine is distinctly taught, both by Christ himself and by his apostles; and there is one passage in which it is spoken of in such a manner, as to throw a very pleasing light on the intention of this wonderful arrangement. It is said that God hath given his Son authority to execute judgment, "because he is the Son of Man."* There is in this a condescension to the condition and feelings of the human race, which, however astonishing, is yet in perfect harmony with the Divine character, as exhibited both in the works of creation and providence.

It is impossible to view the Eternal Creator of the universe, without feelings of awe and terror. There is something so prodigiously grand and amazing in the idea of a Being infinitely perfect, who sustains all things by His own inherent energy, and who is at the same moment present throughout the immensity of His works, that the mind shrinks back with dread, and feels as if it were annihilated in his presence. Even when this self-existent Being condescends to appear in the most amiable and endearing light,—when He assumes the character of our father and friend, the imagination cannot altogether divest Him of the terrors of His majesty. We still see Him dwelling in light inaccessible and full of glory. We behold the angels veiling their faces in His presence, and the pillars of heaven trembling at His

* John v. 27.

nod. Our confidence is lost in veneration, and our love is overpowered by fear; and the language of our hearts is, "Lord, what is man that thou art mindful of him, or the son of man that thou visitest him?" When, to this feeling of inferiority, is added the remorse of a guilty conscience, we can no longer endure a sense of the Divine presence; our hearts sink within us, and we hide ourselves in the dust. This sentiment is emphatically expressed in the book of Job:—"Behold the heavens are not clean in his sight, and he charges his angels with folly. How much more abominable and filthy is man, who drinketh iniquity like water."

It is this condition of fallen man, so insignificant, abject, and guilty, when compared with the infinite perfections of his Creator, which stamps such a peculiar value on the whole scheme of revealed religion, and which especially endears to the heart of the sinner that astonishing exhibition of mercy displayed in the atonement and intercession. Nor is there less ground of reassurance in the light thrown on the Divine character and intentions by the appointment of the *Son of Man* to be the judge of the guilty race of Adam.

That our fate in a future world shall in some way be regulated by our conduct in this, is the dictate of natural as well as revealed religion. "Whatsoever a man soweth that shall he also reap. He that soweth to his flesh, shall of the flesh reap corruption; but he that soweth to the spirit, shall of the spirit reap life everlasting." But though this is a doctrine on which men are generally agreed, yet an important point remains still to be decided. What are the precise limits of our election or condemnation? At what particular step, in the progress of guilt, is the favour of the Righteous Governor withdrawn; and what degree of holiness, or what other qualification is required, for enjoying his approbation and blessing?

To determine this important question, reason is totally inadequate. The only discovery to which this feeble

guide can lead us, is, that none of the creatures of God can demand an eternal reward as their right; that imperfect and guilty beings such as men, are at best unprofitable and unfaithful servants; and, instead of the favour, have rendered themselves liable to the displeasure, of a just and holy Judge.

Hopes of the Divine mercy, indeed, it is flattering to entertain; but, in the religion of nature, these are not founded on any rational conviction. They are only vague and unsatisfactory conjectures, which our consciences reject, and which can never form a proper ground of trust and confidence; or, shall I not rather say, they are altogether false and delusive. The discoveries of revelation, however, are more important and favourable. The Gospel directs us to "the blood of sprinkling, that speaketh better things than that of Abel." We are assured that Christ died "the just for the unjust, that he might bring us unto God." And thus that the mercy and justice of the Divine nature are reconciled, and the sinner who believes, and accepts the offered mercy, is placed in a state of grace.

But still a dark and impenetrable cloud hangs over the councils of the Almighty; the exact boundaries between the kingdom of God and the kingdom of Satan remain to mortal vision undefined; and the children of Zion tremble while they rejoice. In this state of uncertainty, it affords to the servant of Christ unspeakable relief to reflect, that his eternal doom is to be decided by his beloved Master; that the same Jesus, who on earth died for his sins, and now pleads his cause in heaven, is, at the last day, to sit in judgment on his soul, and to appoint his station in the world of spirits. When he reflects on his own worthlessness, indeed, he doubts and despairs. But when he turns his eye upon his Redeemer and Judge, his faith expands, and his hope revives, till, at length, after many fears and many conflicts, all the consolations and encouragements of the Gospel come to cheer him in the path of duty. Every

circumstance in the life of his eternal Judge which proves his love to man, is to him a ground of hope and comfort. "He who came down from heaven to save a guilty world," will the experienced Christian say, "and submitted to the pain and ignominy of the cross, that he might give eternal life to his enemies, will not shut his ears to the cry of the broken in heart; he will not turn away with unbending severity, from the believing and penitent sinner who longs for his salvation, and strives to gain an interest in his love. The gentleness, the kindness, the meekness, and the patience of his nature, all encourage me to hope. Every tear which he shed over suffering humanity,—every sigh which escaped him for the prevalence of sin,—every pang he endured in accomplishing the salvation of man, is a new pledge of the interest he takes in my welfare. I will go to him with holy confidence; I will throw myself at the footstool of his mercy—or, rather, I will fall into the arms of his love. I shall find in my Judge a friend and a brother. With a smile of encouragement he will say to my soul, 'Fear not, I am the First and the Last: I am he that liveth and was dead, and behold I live for evermore, and have the keys of hell and of death. Continue thou in my love; and because I live thou shalt live also. Thy transgression is forgiven,—thy sin is covered. Come thou blessed of my Father! inherit the kingdom prepared for thee from the foundation of the world.'"

TENTH WEEK—MONDAY.

QUADRUPEDS.—THEIR CHARACTERISTICS.

The division of lower animals, which in this and the papers immediately following, is to engage the reader's attention, is generally placed by naturalists highest in the scale of importance. The frame-work of the va-

rious species of quadrupeds, though this differs widely in different classes, makes the nearest approach to the perfection of the human body, and, in many of them, there are points in which that perfection is rivalled, and even exceeded. It is not difficult, indeed, to trace through every class of this extensive order, a similarity more or less striking to man; and while in one the limbs are stronger, in another better adapted for agility, and in a third for swiftness, to point out in every species the bones, muscles, and organs, which correspond to those of the human family. The ape, in all its varieties, presents, even to the eye of a child, a ludicrous caricature of the human form and features. But even in the dog, when at his master's command he erects himself upon his hinder legs, it is at once observed that there exists a striking resemblance in his general structure to his nobler fellow-creature. If we examine the parts of his body with minuteness, we shall find that the forelegs, which require no great stretch of fancy to convert them into arms, are formed like our own, of several bones closely jointed together at their extremities, and each clothed with muscles adapted to its own purposes, capable of bending out or in, though less perfectly, still in a similar manner, and only differing in this, that while the hand and arm of man are fitted to enable him to perform the functions of a rational being, the foreleg and paw of the dog are calculated for the humbler services of tearing his prey, and aiding his locomotion. If we turn our attention to his posterior extremities, we shall find the haunch, the thigh, the shank, the heel, and the foot of man, distinctly represented in those of the brute, though suited to the structure of the rest of the body to which they belong. This resemblance, though it is visible even in the birds and fishes, is in these classes comparatively faint and imperfect, and the nearer approach to perfection on the part of quadrupeds, which this similitude to the human family seems to indicate, is confirmed by other observations. It is true,

that birds possessing the advantage of wings, are more rapid in their journeys, and more discursive in their habits. They can leave the swiftest quadruped far behind, and need no ship to waft them beyond the sea,—but their bodies are necessarily lighter, and their limbs less muscular, while the brain is smaller, and they are in general much inferior in sagacity. The eagle, the noblest of the birds, will not abide a comparison with the lion or the elephant.

In casting our eyes over the various species of quadrupeds, we see them placed in all latitudes, and intended for every conceivable mode of existence. One subsists on roots; another on leaves and herbage; a third on grain; and a fourth by preying on its weaker neighbours;—and, as we might have expected, the structure and organs of each are beautifully adapted to the situations they occupy, and the mode of life they are intended to pursue. The more narrowly we inspect the faculties of these creatures, with reference to their circumstances, the more clearly will we perceive the truth of this assertion. Compare, for example, if it can be done without a smile, the structure of the mole with that of the cat,—the former dwelling in a subterranean apartment, habitually forcing its way through earth, and stones, and gravel,—the latter subsisting on birds and mice, which it seizes by means of its teeth and claws, with an agility the most surprising. The mole, to facilitate the means of its existence, possesses a round body, clothed in a smooth coat of hair, soft as velvet, and so close, that the soil cannot penetrate it. Its snout is hard and cartilaginous, like that of the hog. Its anterior extremities consist chiefly of feet, resembling the human hand, fixed to the sides, without the intervention of legs, and admirably suited to the purpose of removing the earth, as it pushes its way. Its eyes are made so small, as hardly to be perceptible, in order that it may not be incommoded by the dust or the sand through which it passes; while the ears, which are peculiarly sensitive,

are securely defended from every ordinary annoyance. The first appearance of the mole at once proclaims its entire unfitness for existing on the surface of the soil, and demonstrates that the Creator intended it to burrow under ground. The cat, on the other hand, gives direct and unquestionable proof of its superior destiny. The eye, active and suspicious, turns with rapidity from one point to another, in search of a victim, or in preparation for escape. The ear, pricked up as in the act of listening, gives instant notice of all that occurs immediately around it, and keeps the animal in readiness to spring upon its prey, or to fly from its pursuers, as circumstances may direct. The limbs, both posterior and anterior, are admirably suited to its natural disposition, being formed more for agility and sudden impulses, than for sustaining lengthened and persevering exertion. The hinder legs, composed of the usual number of bones and joints, every division of which is long in proportion, much inclined, and moved by muscles of great activity, afford all the advantage of a lengthened and rapid spring, without imposing the awkwardness of limbs stretching to an immoderate length from the body. The forelegs, clothed with flesh, which is more tendinous than muscular, and armed with claws of great sharpness and power, give the little animal a manifest superiority in striking its victim, and defending itself against oppression.

The difference in structure, which is so easily perceived between the mole and the cat, is not less remarkable, though it may be less striking between the latter and its neighbours of the canine race. The cat is formed for very rapid, but not for long-sustained, movements. It leaps upon its prey. It climbs the nearest tree when flying from its enemy, or it skips about in graceful gyrations, when indulging in a mirthful mood; but its motions are all sudden, and soon over; and we have seen how its structure answers to its habits. The dog, on the other hand, depends mainly upon his perseverance.

Having once perceived the scent of his prey, he seeks to overtake it, more by the constancy and ardour of a sustained pursuit, than by extreme speed of foot. Accordingly, his limbs are formed rather for continued running, than for making a sudden spring. The hinder leg is less bent, because its parts are shorter in proportion to its height. The paws and fore-legs are not so formidably armed; nor does he require that they should be so, for his prey is generally exhausted by its efforts to escape, before it is secured. His eye is less keen, but his sense of smell, on which he chiefly relies, is more acute. The hare and the rabbit escape from him by superior swiftness, and, when taken, it is because their powers of endurance, or their steadiness and perseverance, are inferior to his. Their structure is not less adapted to their necessities than his, and the struggle between the constancy of the one, and the speed of the other, is not more interesting to the sportsman, than instructive to others. There is no department of this wide field; in which there do not exist proofs, as beautiful as they are ample, of the adaptation of the animal creation to the posts appointed for them respectively in the economy of the world.

G. J. C. D.

TENTH WEEK—TUESDAY.

QUADRUPEDS.—THEIR BODILY ORGANS.

In this highest order of the inferior animal creation, the bodily organs are more fully developed than in the orders below them. This paper shall be devoted to a brief consideration of one of these organs, as modified in different species, so as to answer the peculiar ends to which the animals are respectively destined. With regard to birds, I have already noticed such variations in the different forms of their bills, and I shall therefore begin by examining the corresponding organ in quadrupeds.

The mouth, in this order, is formed on a different principle from that of birds. It is not intended to cut the air like that member in the winged tribes, nor like it to act as a hand, for the capture of prey; and therefore the peculiar conformation which constitutes a bill was not required. There were other specific ends which the habits and functions of beasts required in reference to their food; and the adaptations by which these ends have been effected, form of themselves a delightful and improving study. If we regard the teeth, the mechanical contrivances are so ingenious, and the variations so admirably adapted to the different kinds of food, and the habits and powers of each animal, that in these alone we might find a demonstration of a wise and benevolent Contriver. So true is this, that not only from the form and arrangement of the teeth in the jaw, but even from the construction of a single tooth, a skilful comparative anatomist can with certainty assign the food and mode of life of the animal, and various other particulars of its physiological character. In ruminating animals, for example, there is one kind of teeth,—in beasts of prey another,—in gnawers a third,—in animals who live on both flesh and vegetables a fourth. These varieties are constantly found combined with a difference of function. But not only so, every peculiarity of food and habit is consulted; and there are, under each of these general heads, numerous subdivisions, the object of which can in most instances be distinctly traced.

If, from the teeth, we pass to the mouth itself, we discover the clearest evidence of premeditated intention. There is system within system, and variety within variety, all bearing a studied reference to the nature and instincts of the animal. Compare, for example, the mouth of the cow or the horse, with that of the wolf or fox: you see at once that the breadth in front of the one was constructed for grazing,—and the narrowness of the other, and its length of jaw, was intended to afford a powerful forceps for the detention or killing of its living

prey. In the feline kind, the shortness is compensated by the greater length of the teeth, and by the talons. In the hog, the variation is even more striking; where the mouth, appearing at first as obstructed by the protrusion of the nose, forms a scoop, following in the track which the latter has ploughed for it, and thus seizing the roots which the snout has loosened or laid bare. These are specimens of peculiar arrangements, and they are only specimens. The adaptations are universal.

The feet of quadrupeds afford an example of adaptation scarcely less striking. The arrangements run through all the species, with a wisdom of contrivance which becomes the more apparent the more it is examined. Let the foot of an ox be compared, for instance, with that of a horse, in reference to their respective natures and destinations. The horse was intended for hard ground and rapid motions; and the hoof is constructed accordingly, answering its end perfectly in a state of nature, and well adapted for the defence which man has contrived for it under domestication. The place of the ox was on meadow lands, and on soft grassy plains; this also is provided for, in the divided and spreading hoof, and in the dew-claws. Compare these again with the goat, whose destination is to ascend rocky precipices, and to find a precarious footing on the steep declivities of the mountains, and with the sheep which must make its narrow track along the sides of the hills,—and the adaptations in these instances also will become apparent. Still further, the foot of the camel, which is a broad, elastic, and soft cushion, is perfectly suited to those sands which, as I have elsewhere remarked, every peculiarity of its construction shows to be its intended dwelling-place. The rabbit was intended to run, as well as to dig and burrow,—the mole only to dig and burrow; let the construction of each be examined with reference to this difference of design, and its wisdom will be manifest. The mouse and rat can walk without difficulty on surfaces not horizontal, by means of the sharpness of their

claws, united to their great strength, and the lightness of their bodies; for the walrus, however, whose destination was also to climb, another provision was necessary, and this was found, not in mechanics, like the other provisions, but in an abstruse philosophical principle. This amphibious animal, equally ponderous and inactive, is compelled to clamber over inclined and smooth rocks, in quitting the sea; and this object is attained by enabling it to produce a vacuum in the sole of its foot, like that by which children amuse themselves in lifting great stones, with a piece of moistened leather attached to a string. This remarkable contrivance is not confined to the walrus; it is not only found in numerous insects, as has already been mentioned, but in the gekko of India, where it is interesting to remark the different construction adopted in relation to its necessities. Each toe has transverse cavities, opening by slits below, which can be rendered vacuums by muscular action. By this means, it is enabled to run, with considerable speed, up the smooth walls of chunam, with which the houses of that country are usually covered.

Were we to examine the legs of quadrupeds, we should not be less struck with their admirable adaptations; some being formed for speed, others for climbing, others for leaping on their prey, or seizing it; and others again for strength to sustain an enormous body, such as those of the elephant; but the field which this opens is much too extensive to be at present entered upon; and I shall conclude this branch of inquiry, by a short reference to the hair of this order of animals.

It has already been shown, how admirably the feathers of the winged tribes suit their peculiar functions as tenants of the air. The hair of quadrupeds is a covering of a different kind, adapted to their peculiar situation in the plan of existence. In hair, the great variations consist in quality, length, and density; while different qualities, such as hair and fur, are sometimes united. The general purpose is warmth; and the chief proof of inten-

tion in the variations, lies in the modifications to adapt this covering to different climates. I have already noticed this subject with reference to winter;* and I shall merely desire the reader here, to attend to the non-conducting and non-radiating properties of this covering, its annual renewals, its variations in quantity, or density, or quality, according to the variations of temperature, and its occasional power of changing colour, so as to adapt itself to that of the ground, or to some alteration of climate.

In all these particulars, and a hundred others which might be named, the structure and condition of quadrupeds, clearly exhibit such benevolent design, such a minuteness of attention to their circumstances and wants, as to furnish new and most interesting proofs of an unceasing and universal exercise of the Divine perfections in the works of creation.

TENTH WEEK—WEDNESDAY.

QUADRUPEDS.—THE BAT.

In ascending from birds to quadrupeds, we meet with a family of animals which seems intended to form the connecting link between the two orders, thus completing the chain of animated nature, in this, as we have seen to be the case in other transitions. This family is that of the bat.

It is not one of the least remarkable proofs of the wisdom of the Creator, that each object or being in nature has been so perfectly fitted for its end, and the station it occupies, that those which, on the first view, are thought mis-shapen or disgusting, become, on closer investigation, the sources of pleasurable and instructive contemplation. Each part is found so well adapted to its use, that the changes which might appear to the superficial

* "Winter," pp. 284, 289. Third edition.

observer conducive to elegance or beauty, would but hinder the design, and produce confusion, where all is order and harmony. Of this the apparently ungainly form of the bat is an exemplification. Daubenton thus describes its structure:—"The elbow is found near the knee; the fore-arm is very long, and obliquely extended from above downwards, and from behind forwards, as far as the nose of the animal. The wrist is placed against the ground, and there is but one finger on the anterior extremity, which is the thumb. The knee is raised as high as the lower part of the rump, and the five toes of the hind feet are of equal length, and turned outwards. The arm is extended horizontally, from the front to the back part, and the thigh vertically, from above downwards; the arm is concealed behind the fore-arm, and the thigh behind the leg; they are, moreover, enveloped in the membranes which conceal the tail, and all the hinder parts of the body. Besides the thumb seen on the anterior extremities, there are four very long fingers, extending from the fore-arm, enveloped in the membrane, and folded, near the elbow, by their extremity."

While on the ground, these long extremities are of little use to it, and it stands propped on the breast, appearing one of the most helpless and awkward quadrupeds in existence. To move along, many different and very fatiguing actions are required. Its pace is heavy and dragging, and it runs in a grotesque and ungraceful manner. The ears are often very large, and, together with the whole membranous surface, are quited naked; the eyes are small, and too weak to endure the light of the sun; and the wide mouth, reaching from ear to ear, completes the uninviting picture. Were we to look no further, we might deem that the skill which lives through all creation, had been withheld from this feeble and imperfect animal. But when, gaining the aid of some slight eminence, it raises its fore-legs, unwraps from about them the numerous folds of its velvet wings, and darts

away with tremulous but rapid flight, we see that it is not dependant for change of place, on the motion that has excited our pity; and, on pursuing the investigation, we find that every part of its structure has been so contrived, by a wisdom far above ours, as to make its existence easy and pleasant. Though the arms of the bat are much elongated, the bones of the fingers exceed their whole length. Over these is stretched the leather-like membrane, which constitutes the wing; it is only a prolongation of the skin, the back and belly each furnishing a layer, and yet it appears but a delicate and transparent net-work. Were the membranes, or bones which support it, compact and thick, their weight would disable the bat from using them; but, becoming thinner as they recede from the centre of motion, they are the instruments of its high and unimpeded flight. The pectoral muscles, which move the wings, are strong, and the breast-bone projects, that these may have an ample space for fixing upon. By means of this construction, the bat is enabled to fly very swiftly. It is gradually aroused from the torpor of winter, at the approach of a milder season, and, slowly recovering the power of motion in the dark recesses of its cave, at length goes forth in search of the insects which have been called into life and activity by the returning power of the sun. It readily discerns its prey, even at some distance, and darts at it, ascending at times, in the chase, to a considerable height, though, in general, it finds a more abundant supply while hovering near the ground, or skimming the surface of water. Here the softness of its wings is of essential service, as they swiftly cut the air, without making any sound to warn the insect into flight or concealment. Though in damp weather the bat can remain for days without food, and even sink again into torpor, his appetite is voracious, and he clears the air of swarms of insects, which, if not exposed to that and similar destructive agents, would multiply so fast as to encumber it, and render it unwholesome. The small eyes of the bat

are less liable to injury than they would be if larger or more protuberant; and they are not made to bear the glare of day, as its season of activity is during the obscurity of twilight, when alone it can obtain food. As if conscious of this, its exertions are, during that period, unremitting, and often continue till the night is far advanced. Notwithstanding its faint power of vision, and even when totally deprived of it, the bat pilots itself through the air, with the greatest skill, avoiding every impediment, though no larger than a twig, and accurately seizing its minutest prey.* This is imputed by some naturalists to its acute perception of sounds, and by others to the delicacy of its nerves; but Cuvier, more philosophically, refers it to the sense of touch resident in the membranous skin of the wings, affected by the reaction of the air in a near approach to any object. Here again we must admire the wisdom that launched this little being on its airy way; for, had this skin been covered by the reddish fur which clothes the rest of the body, that keen sensibility would have been destroyed, and the bat must have darted recklessly along, always in danger of being stunned or wounded by striking against objects which it could not discern, and snatching at random, and in vain, for food, till, spent and weakened, it met a painful death. The large and powerful mouth, and sharp teeth of the bat, enable it to put its victims out of pain instantaneously, and by one gripe. While stationary, it frequently fixes itself by the hook of its hind feet, on some projection, and hangs securely, with the head downward, and the wings folded on the breast. This inverted position is most curiously adapted to its wants, and compensates for the difficulty

* Various experiments have, at different times, been tried, in order to ascertain how far, and under what circumstances, the peculiar faculty or sense, which supplies the place of sight, is called into operation; and it has been found that, though the eyes be sealed up, or even removed entirely, and the animal let loose in a room, with a thousand intricacies and objects, it will pursue its abruptly wheeling flight as usual, threading every labyrinth, avoiding every obstacle, and all this with the same ease, quickness, and precision, as would have been the case had the sight been ever so perfect.

it has in rising from a flat surface; for, by merely loosening its hold from the rock or tree, the creature is at once in the air, on unrestrained and buoyant wing.

The species of British bats have been computed by naturalists to amount to fifteen or sixteen, but if we take into account those that are to be found in foreign countries, we cannot estimate the whole as fewer than two hundred. Some of these are very large, compared with the kinds we are acquainted with. The kalong, for example, a species described by Mr Horsfield, which is very abundant in the lower districts of Java, is said to be fully five feet in the extent of its expanded wings, and one foot in the length of its body. This is a fruit-eating kind, and is generally found in companies of several hundreds, fixing on a tree for their roosting-place, where, suspended in rows or clusters, by their hinder claws, with their heads hanging downwards, and their wings folded round them, they exhibit a singular spectacle. During the day they are in general silent, though, if disturbed, they utter "sharp piercing shrieks." Soon after sunset, they leave their roosting-place, and begin their nightly search for food.

The vampire, of which such dreadful stories have been told, is of the same tribe. It is a blood-sucking species, and has been said, while banqueting on the blood of its victim, to fan him with its wings, so as to lull him into a profound sleep, from which he never awakes. This is an entire exaggeration. Don Felix d'Azzara, an accurate observer, who had personal experience of their power, says, "The wounds which they inflicted, without my feeling them at the time, were circular, and rather eliptical; their diameter was trifling, and their depth so superficial as scarcely to penetrate the cutis. It was easy, also, on examination, to perceive that these wounds were made by suction, and not by puncture, as might have been supposed. On so trifling a basis are the airy visions of superstitious terror found frequently to be erected, when subjected to calm philosophical inquiry."

These facts require no comment. Small and uncomely as is the bat, consecrated of old to gloom and Proserpine, there is a multitude of nice adjustments in the mechanism of its frame, and the omission of but one of these would have destroyed the efficiency of all the rest. But nothing is wanting, nothing is out of place. Each part of the structure is in perfect accordance with every other, and all combine to adapt the animal to its position in the scale of creation. We admire the gorgeous butterfly, borne past us on the breeze of summer; our eyes pursue the ascending lark, till he is lost in the glories of morning; but Almighty skill is not more apparent in the rich penciling of the butterfly's wing, than in the soft transparency of the bat's; nor is Almighty goodness less evident in forming the bright eye of the lark to greet the rise of day, than in consigning the darksome bat to the grey shades of evening. The more eagerly we cast the eye of intelligent inquiry on the meanest and lowest objects in nature, the more clear will be our perception, increasing at every stage of our progress, of the depths of that unfathomable Wisdom which

> "Sees all, as if that all were one,
> Loves one, as if that one were all."

M. L. D.

TENTH WEEK—THURSDAY.

QUADRUPEDS.—THE MOUSE.

The harvest-mouse is the smallest of quadrupeds, two being only equal to the weight of a halfpenny. The delicate formation of its slender limbs might make it appear incapable of doing either good or evil to mankind. Yet so great are its numbers, that large quantities of grain are devoured by them; and the labourer sees the produce of his fields, nourished by the early rains, and matured by the autumnal sunshine, fall a sa-

crifice to these insignificant depredators. Few things are more deserving of admiration, than the beautifully constructed nest of the harvest-mouse. Suspended on a bean or thistle, or a few stalks of wheat, it waves securely in every passing breeze. It contains eight young ones, which, being blind, naked, and helpless, would be much injured, if not destroyed, by a fall, and to prevent this, the aperture is closed by the parent with so much skill, that it is difficult, even on a near examination, to discover it. This aerial dwelling is round or oval, and formed of the plaited blades of grass or wheat; and the mouse climbs the perpendicular ascent to visit her young by means of a prehensile tail, with which she seizes and clings around it. These creatures are brought home in great numbers in the wheat-crop, or found in shallow burrows beneath the bean-ricks. In winter, they congregate for warmth in hollows, lined with grass and other soft materials, and subsist on the food they have providentially laid up in the season of abundance. Thus are they guided on from infancy to maturity, and enabled to meet the demands of their brief existence, by the gracious Being, who never bestowed it on any, without imparting to them the means of making it safe and pleasant.

The meadow-mouse is another very small species of this animal. It chooses its abode in grass-fields, making numerous and widely branching burrows along the sides of drains, or the embankments thrown up to prevent the rising of streams. Here these active miners incessantly ply their labours, till, by their long and united efforts, assisted by the action of the water on the cavities they form, the hollowed bank sometimes falls in, and the stream flows unchecked over the wrecks of human toil and ingenuity. Their warm and compact nests resemble those of the smaller birds, and are placed upon the ground, in the shelter of the grass, of which also they are made. In mild weather, they remain above ground, and their well-trodden lanes may be tracked in

many directions among the long grass. They multiply very rapidly, but are kept down by the attacks of many foes, and afford a large supply of food to the owl of the twilight, and the quick-eyed hawk.

But the waving corn-field and the luxuriant meadow are not the scenes most congenial to all the branches of this numerous race. The desolate marsh affords its favourite shelter to the marsh-campagnol; and it sports among the mud, or stationing itself on the reeds, patiently waits till the waters subside. Its prevailing hues are dingy brown and grey; and when in a state of repose, it more resembles a piece of its native mud, than a brisk and lively creature, possessing the powers of swimming, diving, and running, and making active exertions for the supply of its wants.

Nor are the deep recesses of the forest without their proportion of this extensive family; for the wood-mouse spends its summer months among them, and when chilled by the cold of approaching winter, seeks a warm, though not a more secure retreat in the habitations of men. It pierces itself a cell in the trees; and not even the hardest timber can withstand the incision of its strong teeth.

The jumping-mouse of Canada closely resembles the common mouse; but its hind legs are very long, and enable it to move in the same way with the kangaroo. When pursued, it darts forward, and clears five or six feet of ground at every leap, and in this way it can advance with great swiftness for some time, resembling a flying bird, as it lightly poises its small frame in the air. It has also the power of running at pleasure. It feeds on the produce of the fields, and during the winter remains torpid, sometimes penetrating to the depth of twenty inches below ground, and snugly coiling itself up in a ball of clay.

The common mouse, so remarkable for its swiftness and vigilance, is about three and a half inches in length. Though it is generally viewed with prejudice and dis-

like, He who assigned to it its form, and its place in the scale of creation, has not disdained to impart to it a great deal of grace and beauty. Its ears are of a very delicate texture; its eyes are large, brilliant, and intelligent; and its long whiskers are in frequent motion. When it goes forth in search of food, or frolics about in the fulness of enjoyment among its associates, it is a picture of animation and elegance. But its extreme watchfulness and timidity, which constitute its chief protection, make it difficult to observe it to advantage; for man, in days of innocence the guardian of the bestial tribes, is now the object of instinctive terror to those defenceless creatures, whose only resource in time of danger is a speedy flight.

The effect of fear upon the appearance of the mouse is thus described by an amiable naturalist:—"One of my boys caught a mouse in school a few days ago, and directly marched up to me with his prisoner. I set about drawing it the same evening; and all the while the pantings of its little heart showed it to be in the most extreme agonies of fear. I had intended to kill it, in order to fix it in the claws of a stuffed owl; but happening to spill a few drops of water near where it was tied, it lapped it up with such eagerness, and looked in my face with such an eye of supplicating terror, as perfectly overcame me. I immediately untied it, and restored it to life and liberty. The agonies of a prisoner at the stake, while the fire and instruments are preparing, could not be more severe than the sufferings of that poor mouse; and insignificant as the object was, I felt at that moment the sweet sensations which mercy leaves in the mind when she triumphs over cruelty."

The economic campagnol is another branch of this family, inhabiting Kamchatska and several parts of Siberia, well deserving attention, both for the skill with which it make its burrow, and for its remarkable migratory habits. For what reason its migrations are undertaken, does not appear to be distinctly known, but the

instinct seems to be of a very energetic nature. "In the spring," says Dr Grieve, "they assemble in amazing numbers, and proceed in a direct course westward, swimming with the utmost intrepidity over rivers, lakes, and even arms of the sea. Many are drowned, and many are destroyed by waterfowl or rapacious fish." "About the middle of July, they generally reach the rivers Ochetska and Judome, a distance of about a thousand miles." The manner in which they cross the rivers of Iceland, of which they are also natives, is thus described by Mr Olafson:—"The party, consisting of from eight to ten, select a flat piece of cow-dung, on which they place the berries they have collected, in a heap on the middle. Then, with their united force, drawing it to the water's edge, they launch it and embark, placing themselves round the heap, with their heads joined over it, and their backs to the water, their tails, pendent in the stream, serving the purpose of rudders." If it were not that there is nothing too wonderful for the instinct breathed into the inferior animals by the inspiration of the Creator himself, this account might be rejected as fabulous. Mr Pennant defends its credibility from the known instincts of beavers and squirrels; and Mr Henderson, who made it his business to inquire into the truth of the statement, considers it to be "now established as an important fact of natural history," having had it confirmed to himself by the testimony of two eye-witnesses of unquestionable veracity, whom he names. He adds further, what certainly increases our surprise, that they are said to "make use of dried mushrooms as sacks, in which they convey their provisions to the river, and thence to their homes."*

M. L. D.

* Henderson's Iceland, vol. ii. p. 186, 187.

TENTH WEEK—FRIDAY.

RUMINATING QUADRUPEDS.—THE GOAT AND SHEEP.

To describe even a few of the most remarkable quadrupeds, which the Creator has spread over the face of the earth, though in this exercise we should certainly find every where new cause of devout admiration and gratitude, would occupy too much space in a work which comprehends in its range such a variety of subjects. I find it necessary, therefore, now to limit my attention to those animals which have been domesticated for the use of the human race. Among these, several highly important varieties belong to the class of ruminating animals. Of this class, all are valuable to man, as supplying him with food; from many he derives his clothing; others labour for him, as beasts of burden; their flesh, their hides, their horns, their hoofs, are all useful; and those which he has taken more exclusively under his protection, repay him a thousand-fold for the care they require at his hands. With this order the prosperity of the human family is intimately connected;—peaceful tenants of the earth, they add, by their presence, fresh and more cheering beauties to vale, and lawn, and mountain, and impart life and spirit to the scenery of nature. The sheep and goat, the ox and the camel, form a portion of the national wealth of every kingdom where they are domesticated, and conduce essentially to the comforts and conveniences of life, and to the progress of arts and civilization.

The whole species of the ruminating order are intimately connected in their physiological character and properties; insomuch that the gradations of their forms preserve an uninterrupted correspondence, even in those cases where we cannot account for their relations. "He who observes only the print of a cloven foot," says Cuvier, "may conclude that the animal who left this im-

pression ruminates; and this conclusion is quite as certain as any other in physics, or in moral philosophy."* This is but an example of the mysterious harmony which the Creator has imposed on Nature.

Every one understands what is meant by ruminating, or chewing the cud; and I shall merely state, that animals of this description, which are all herbivorous, have their stomach divided generally into four, and always at least into three distinct cavities or chambers, the first of which serves as a receptacle for the grass or herbage, coarsely ground by the first mastication; and in the second of which, the mass, entering by degrees, is compressed, divided, and compacted into small balls, which are returned, by a voluntary action, into the mouth, to undergo the second process of mastication. During this operation, the animal reposes at ease, until the food it has taken has been all subjected to the like process. As soon as the ball is re-ground, it is swallowed directly into the third and fourth chambers, where it undergoes the digestive process.

Having already described the camel, I pass on to the goat and sheep tribes, whose families are so nearly allied in structure, that naturalists have been exceedingly puzzled so to define them as to mark the specific difference, and have at last been under the necessity of fixing on two very unimportant appendages as their ground of distinction,—those of the horns and beard. The goat is marked by the possession of a beard, and some radical difference in the *tornure* of the horns. There is also a slight variation in the line of profile, that of the sheep

* It may at first sight appear that the hog is an exception to this rule, so peremptorily laid down by Cuvier, but although this animal is in a certain degree cloven-hoofed, he differs in the conformation of his feet very materially from other animals which are marked with this peculiarity. He appears, indeed, to have only two toes, but he has actually four concealed within, and the other bones of the foot have no resemblance to those of cloven-footed animals.—"All that can be said," observes Buffon, "is, that in some respects he forms the link between the whole and cloven-footed animals, and in others between the cloven-footed and digitated animals."

being more convex than the profile of its congener. In other respects, the two species run so much into each other, in different varieties, as to preclude the possibility of fixing on any permanent and well defined distinction. In Scripture, the same word is used to designate the young of both species, and lambs of the sheep or of the goats were generally employed indiscriminately in their sacrifices.

There are various allied families of the goat kind included under the general title of Antelope, of which the chamois of the Alps is one of the most remarkable, and the only species that is a native of Western Europe. The wild goat, or *paseng*, is found in herds in the great mountain-chains of Asia, where it bounds wild and free. Its size is superior to our domestic breed, but in all essential characters it is the same.

The domestic goat offers, like all thoroughly reclaimed animals, over which man has held a long-continued influence, an almost endless number of varieties, in respect of its size, its colour, and the quality of its hair. The goats of Angora and Cappadocia have long been celebrated for their soft and silky hair, forming the staple of the cloth called camlet. In Thibet there is a breed furnished with an undercoat of wool, of exquisite fineness and delicacy. It is from this that the highly valued Cashmere shawls are fabricated. Upper Egypt, on the contrary, has a race with close smooth hair, a convex forehead, and a projecting lower jaw. This is supposed to be the species so frequently alluded to in Scripture. It is still abundant in Syria, where it is kept, as in early times, in flocks.

From the goats, let us turn to the more important order of the sheep; and here too we shall find varieties too numerous to be detailed, and to the number of which the skill of the cultivator is constantly adding. In every age, the sheep has been among the most valued of man's possessions. It is the first reclaimed animal of which we have any account, and seems to have been taken

into the protection of man immediately after the fall; for we find Abel mentioned as a "keeper of sheep."

In every country, the sheep offers peculiar modifications of character, produced, doubtless, by a combination of circumstances. Among our European breeds, none are more celebrated for their wool than the Merino sheep of Spain, which have been transferred to Britain, and other European countries, and to New South Wales, which latter region is peculiarly favourable to the rearing of its valuable produce. In hotter climates, the fleece gives way to hair, and loses its form of wool. Among the singular varieties of this animal, I may mention that of Russia, which is distinguished by a long trailing tail; of India and Guinea, which to an elongated tail adds long pendent ears, short and smooth hair, a marked convexity of forehead, without horns, and long and slender limbs; that of Persia, Tartary, and China, which has a tail transformed into an enormous double globe of fat; and, lastly, that of Syria and Barbary, whose tail is of considerable length, consisting of a mass of fat, so great that it is often necessary to support it artificially.

But the chief excellence of the sheep consists in the quality of its wool. There is none of the domestic animals of so much value, both in a national point of view, and as regards the purposes of agriculture. They can be reared in situations and on soils where other domestic animals could not be supported; and, in general, they afford greater profit than is derived from the feeding of cattle. The annual fleece which they yield, while it gives a considerable return to the farmer, is of immense importance to our manufactures, and is indeed the staple commodity of the island.

The sheep, from its long domestication, has certainly lost much of its native sagacity, and may be said to be, comparatively speaking, a stupid animal. It throws itself entirely and confidingly on the protection of man, and ceases, in ordinary cases, to think or act for itself. Yet some of its instincts it continues to retain, and no-

thing can be more interesting than the tender regard it displays towards its young. "He who, in shearing time," says Captain Brown, "when the lambs are put up separately from the ewes, witnesses the correct knowledge they have of each other's voices; the particular bleating of the mother just escaped from the shears, and the responsive call of the lamb, skipping at the same moment to meet her; its startled attitude at the first sight of her altered appearance; and the reassured gambol at her repeated voice and well known smell;—he who observes them at these moments, will not refuse them as great a share of intelligence as their ancient subjugation, extreme delicacy, and consequent habitual dependance on man, will allow."*

The lamb has always been held as the emblem of innocence. In the Christian system it is more. It is employed throughout Scripture as a type of Him who was "holy, harmless, undefiled, and separate from sinners." There is no figure under which the Saviour is more frequently represented, and none employed in so many forms. It was used, under the Old Testament dispensation, in the typical sacrifices of the Israelites. In their morning and evening oblations, in their expiatory offerings, and in the sacrament of the Passover, lambs were sacrificed, to represent that "one sacrifice for sins," which Christ offered up, before he "for ever sat down at the right hand of God." Hence he is spoken of as the "Lamb of God who taketh away the sin of the world;" "the Lamb slain from the foundation of the world;" "our Passover which was sacrificed for us;" and his blood shed on the cross is called "the blood of sprinkling, which speaketh better things than that of Abel." A thousand beautiful allusions to the pastoral life, of a different kind, occur in the Inspired Volume, which throw a kind of sacred halo round that earliest of all professions. The pious mind irresistibly forms an association between the office of a shepherd and that of the "good Shepherd who laid down his life for the sheep."

* Goldsmith's "Animated Nature," vol. ii. p. 5, note.

TENTH WEEK—SATURDAY.

SHEEP-SHEARING.

One of the most laborious operations of those who rear sheep, and that in which all the members of a large family may find employment, is the shearing of their fleeces. The adoption of the proper season for that purpose is of great importance, as the quality of the wool in a considerable degree depends on it. The wool must be full grown, otherwise it is weak, and scarcely admits of being spun; and if the time of cutting be too long protracted, it becomes yellow, felted, and imperfect. There never can be any difficulty in ascertaining the proper time for this operation, as Nature points it out, the separation of the old wool from the new being distinctly marked.

In the less advanced stages of society, there are seasons attended frequently with some degree of pomp and ceremony, in which people, by common consent, meet together for purposes of festivity and social enjoyment. The mind seems to court such a stimulus, and this propensity is probably one of the means by which the human powers are expanded, and the progress of society is advanced. The principal season of agricultural festivity are sheep-shearing and harvest-home.

In almost all pastoral countries, a sheep-shearing festival has in every period been customary; differing, however, in the mode of its celebration, according to the particular genius of the age, and the people among whom it was kept. The mind expands when it is overflowing with a sense of prosperity; and in times of simple manners, there is a generous sentiment excited by the bounties of Providence, which induces their possessors to share them with others. This sympathetic feeling passes through whole communities, and hence

the origin of such customs as that now under consideration.

These feasts, like all other great occasions of rejoicing, doubtless partook originally of a religious character; and the practice was not unsanctioned by revelation. Under the Mosaic dispensation, the Israelites had their religious feasts of the first-fruits and ingathering, which were obvious adaptations to this natural tendency. Sheep-shearing festivals, in particular, were very early introduced. Some intimations of the importance of the ceremonial attached to such occasions, are afforded as far back as the time of the Patriarchs; and there seems to be a hint of its religious character, contained in the information that Laban first became aware that his daughter Rachel had carried off his images when he "went to shear his sheep." Further notice of this festival, with some particulars of its nature, as practised among the children of Israel, is given in the life of David. We are told that Nabal, at his sheep-shearing, "held a feast in his house like the feast of a king," and it should seem that on such occasions it was customary to send presents to friends and neighbours, and especially to those from whom obligations had been received. This supposition, at least, accounts for the message of David to that churl. It was "a good day," and he had reason to expect that his men, who had guarded the flocks, would be included among those who shared the bounty of the season.

In England this custom very early prevailed. It was a time of merry-making. The maidens, in their best attire, waited on the shearers, to receive and roll up the fleeces. A feast was made, and a king and queen elected; or else this honour was conferred somewhat in the manner in which Darius is said to have been elected king of the Medes;—not, indeed, by the neighing of a horse, but by the fortunate production of the earliest lamb. In Drayton's Polyolbion, this simple rural festival, as it existed among our forefathers, is thus described:—

The shepherd king,
Whose flock has chanced that year the earliest lamb to bring,
In his gay baldric sits, at his low grassy board,
With flawns, curds, clouted cream, and country dainties stored;
And, while the bagpipes play, each lusty jocund swain,
Quaffs syllabubs in cans, to all upon the plain;
And to their country girls, whose nosegays they do wear,
Some roundelays do sing;—the rest the burden bear.

Thomson describes the same scene, not with more truth, but with more dignity and grace.

At last of snowy white, the gathered flocks
Are in the wattled pen innumerous press'd,
Head above head; and, ranged in lusty rows,
The shepherds sit, and whet the sounding shears.
The housewife waits to roll her fleecy stores,
With all her gay dressed maids attending round.
One chief, in gracious dignity enthroned,
Shines o'er the rest, the pastoral queen, and rays
Her smiles, sweet-beaming on her shepherd king.
A simple scene! Yet hence Britannia sees
Her solid grandeur rise; hence she commands
The exalted stores of every brighter clime,
The treasures of the sun without his rage.

What tends to render this simple festival peculiarly interesting, even to a refined mind, is not merely the sentiment which the poet so beautifully notices, that to her wool Britain is indebted for much of her superiority over other nations, in manufacturing industry and wealth; but also the feelings derived from the delightful season of the year with which it is associated. It is in June, the loveliest month of the year, that in Britain the employment of sheep-shearing is chiefly carried on. This is the season of gay flowers, of sweet scents, of verdant lawns, and of leafy forests.

"Nunc frondent sylvæ, nunc formosissimus annus."

Let him whom business has pent up in a large city, now find his way into the country, and he will feel the bounties of Nature breathing around him, and shedding their delights over his inmost soul. As he walks along, by the bank of some woodland stream, musing in unwonted solitude, or enjoying the society of some intelligent companion, the whole scene is enchantment. The green pastures, where the sober cattle crop the sweet herbage as it springs luxuriantly beneath their feet, or recline on some sunny bank, or in some shady glade, chewing the cud in silent joy; the hills studded over with flocks of sheep, whence at intervals the bleating of the playful lamb is responded to by the voice of maternal affection; the neighbouring groves, in all the leafy pride of summer,

> "Shade unperceived, so softening into shade,
> And all so forming an harmonious whole,"

where music pours its "wood-notes wild," in a hundred varied cadences on the delighted ear; the flowers, which the earth flings in such profusion from her green lap, with their numerous forms and tints, always elegant and beautiful, and their mingled perfume so balmy, grateful, and refreshing,—all raise the well-constituted mind to the contemplation of the great Source of this profusion of bounties,—Himself how bountiful!—In this frame of mind let the admirer of Nature, during his rural rambles, come suddenly on a party engaged in the preparatory employments of sheep-shearing, the most picturesque of all the pastoral operations; the bleating sheep, as they are one by one abstracted from the fold, and plunged into the clear stream, where sturdy hinds are stationed to receive them, and free their fleeces of their impurities; and the busy groups of men, women, and children, each engaged in their several departments, or standing on the brink of the pool, pleased witnesses of a scene attended with so many agreeable associations; the whole animated picture, as it rises on his view, will

excite sensations, which it is more easy to conceive than to analyse.

How deeply seated and how mysterious are the sources of enjoyment, yet how readily called into action. Every thing in rural scenery excites it; the voice of pleasure, from the various tribes of inferior animals, in all their different tones, excites it; the very bustle of business, with the eagerness and emulation arising from some common pursuit, excites it; above all, sympathy with human joy excites it, whether that sympathy is kindled by the smile of pleasure illuminating the countenance of our fellows, or the sprightly conversation of men free from care, or the song bursting from hearts full of gladness. Man is formed to enjoy; and, even in his journey through this chequered world, a bountiful Providence strews his path with enjoyment.

ELEVENTH WEEK—SUNDAY.

CHRIST, THE GOOD SHEPHERD.

The life of a shepherd is interesting, and sometimes adventurous. In pastoral countries, where there is frequently a vast extent of wild mountain ranges, his charge is anxious and incessant. He has to lead his sheep to the best pastures; to prevent them from straying beyond their proper bounds; to seek out the weak and diseased, and nurse them with tender care; in the spring he has to attend to the new dropt lambs; in summer his flock yield their fleeces, and the duties attending this operation, which are numerous, require skill and judgment. During winter he must redouble his care, amidst rains, and frosts, and snows: The grass no longer grows on the hills, and he must seek for it in the valleys; the storms come, and he must find the flock shelter; sometimes the snow falls thick and deep, and buries them beneath its drifted heaps, and the shepherd must seek for them at the risk of his life, wandering over trackless moor and mountain, where all the usual landmarks are covered, and he is in perpetual danger of losing his way, and falling into some treacherous bog, or over some concealed precipice. Still, if he survive these perils, full of affectionate solicitude, he eagerly and anxiously hurries on, accompanied by his faithful dog, till he discovers his lost charge, and extricates them from their fearful situation.

In foreign countries, where beasts of prey abound, the shepherd has additional cares; he must be perpetually on the alert to defend his flock from the attacks of the wolf, the lion, the tiger, and the bear; and his own life, if he be faithful to his charge, is frequently endangered in encounters with these enemies. David, while yet a youthful shepherd, had more than one opportunity of

evincing his courage and fidelity in protecting his sheep from such depredators; and when urging on Saul his claim to encounter the Philistine giant, he thus, with a gallant simplicity, describes his own prowess:—"Thy servant kept his father's sheep, and there came a lion and a bear and took a lamb out of the flock. And I went out after him, and smote him, and delivered it out of his mouth, and when he arose against me, I caught him by the beard, and smote him, and slew him. Thy servant slew both the lion and the bear; and this uncircumcised Philistine shall be as one of them, seeing he hath defied the armies of the living God."

The dog, which is of such essential service to the shepherd in our own days, does not appear to have been employed by the Israelites, notwithstanding they were an essentially pastoral people. The reason may probably have been, that this animal was ranked among unclean beasts; and in eastern countries the habits of the wild race were always ravenous and disgusting. We might be at a loss to conceive how the large flocks reared by that people could have been adequately attended to without the aid of so useful a servant, did we not know, that the Author of Nature has provided, in the instinct of the sheep, the means of obviating the difficulty, and that man, who is fertile in expedients, was not slow in discovering and taking advantage of it. Like various other gregarious animals, the sheep naturally follow a leader, which is capable of being taught to obey the human voice. It is in this way that the flocks of the Israelites were kept under control, and the labours of the shepherd were abridged and rendered efficient.

Mr Murray, in his "Summer in the Pyrenees," gives an interesting account of the obedience of the sheep to the call of the shepherd in these pastoral regions, which throws light on the mode of management among the ancient Hebrews. "The celerity," says he, "with which the shepherds of the Pyrenees draw their scattered flocks around them, is not more astonishing than the process

by which they effect it is simple and beautiful. If they are at no great distance from them, he whistles upon them, and they leave off feeding, and obey the call; if they are far off and scattered, he utters a shrill cry, and instantly the flock is seen leaping down the rocks, and scampering towards him. Having waited until they have mustered round him, the shepherd then sets off in his return to his cabin or resting-place, his flock following behind him, like so many well-trained hounds. Their fine-looking dogs, a couple of which are generally attached to each flock, have nobler duties to perform than that of chasing the flock, and biting the legs of stragglers; they protect it from the attacks of wolves and bears, against whose approach they are continually on the watch, and to whom they at once offer battle. So well aware are the sheep of the fatherly care of these dogs, and that they themselves have nothing to fear from them, that they crowd around them, as if they really sought their protection; and dogs and sheep may be seen resting together, or trotting after the shepherd, in the most perfect harmony. There is no such sight to be witnessed in these mountains as 'sheep-driving,'—no 'knowing little collies' used in collecting the flocks, or keeping them from wandering. The Pyrenean shepherd, his dog, and his flock, seem to understand each other's duties. Mutual security and affection are the bonds which unite them. The same confidence subsists between the Pyrenean shepherd and his flock, as that between the Shepherd of Palestine and his."

What I have chiefly in view in this description of a shepherd's life is, the illustration of those metaphorical allusions which are made in Scripture to that occupation, in reference to the character and offices of the Saviour. The most remarkable of the passages where such allusions are found, is that in which Christ speaks of himself under this image.—"I am the good shepherd," says he; "the good shepherd giveth his life for the sheep; but he that is an hireling, and not the shepherd,

whose own the sheep are not, seeth the wolf coming, and leaveth the sheep and fleeth, and the wolf catcheth them, and scattereth the sheep. I am the good shepherd, and know my sheep, and am known of mine. And other sheep I have which are not of this fold, them also I must bring; and they shall hear my voice, and there shall be one fold, and one shepherd." And again, "He that entereth in by the door is the shepherd of the sheep. To him the porter openeth; and the sheep hear his voice; and he calleth his own sheep by name, and leadeth them out; and when he putteth forth his own sheep, he goeth before them, and the sheep follow him, for they know his voice."*

There are two views of the Redeemer chiefly alluded to in this beautiful metaphor: He is represented, first, as our affectionate guide; and, secondly, as the preserver of our lives by the sacrifice of his own. In reference to the first of these views, we find a similar and scarcely less striking allusion in the 23d Psalm,—"The Lord is my shepherd, I shall not want. He maketh me to lie down in green pastures: He leadeth me beside the still waters. He restoreth my soul: He leadeth me in the paths of righteousness for his name's sake. Yea, though I walk through the valley of the shadow of death, I will fear no evil: for thou art with me; thy rod and thy staff they comfort me." In the prophecies of Isaiah, too, the same sentiment is gracefully and tenderly expressed,—"He shall feed his flock like a shepherd: He shall gather the lambs with his arm, and carry them in his bosom, and shall gently lead those that are with young."†

The intimate and endearing relation which subsists between Christ and his church, is elsewhere represented with not less force, sometimes under the figure of a bridegroom and his bride,—and, at other times, under that of the head, giving life and intelligence to the various members of the body. There is nothing, indeed,

* John chap. x. † Isaiah xl. 11.

too intimate or too endearing to characterize this union. He is our master, our friend, our elder brother; and in all these capacities he directs, advises, instructs us; consults our best interests; exercises over us the gentle authority of a parent, with all the tender affection of an equal. His word is a light to our feet and a lamp to our path: His Holy Spirit enlarges, comforts, sanctifies us; cleanses us from the pollutions of earth; prepares us for the enjoyments of heaven.

But Christ, the good shepherd, is also the preserver of our lives; and at what expense? "The good shepherd giveth his life for the sheep." This crowns all his labours of love. "Scarcely for a righteous man will one die," says an apostle, "yet peradventure for a good man some would even dare to die. But God commended his love towards us, in that, while we were yet *sinners*, Christ died for us." Jesus himself represents the sacrifice of one's life as the highest and most generous act of friendship,—"Greater love hath no man than this, that a man lay down his life for his friends." How then shall we characterize the love of this most amiable and admirable of Beings, when we remember that He laid down his life for his *enemies*. In every way his disinterested affection exceeded that of any mere mortal. To die for a good man and a friend, is the climax of human love; but Christ died for sinners and enemies! His love was boundless, incomprehensible, God-like;—and it is so still. He who died for our sins, rose again for our justification. He is still the shepherd of our souls. "Who shall separate us from the love of Christ? Shall tribulation, or distress, or persecution, or famine, or nakedness, or peril, or sword? Nay, in all these things we are more than conquerors, through him that loved us."

ELEVENTH WEEK—MONDAY.

THE SHEPHERD'S DOG.

In the "Winter" volume I noticed the sagacity of the dog, in extricating its master or casual passengers from danger, during storms of snow. This, however, I need not observe, is only one feature in the character of an animal, which, of all others, is most obviously given to man at once as his servant, his companion, and his friend. Cicero says of this animal, "Such fidelity of dogs in protecting what is committed to their charge, such affectionate attachment to their masters, such jealousy of strangers, such incredible acuteness of nose in following a track, such keenness in hunting,—what else do such faculties evince but that these animals were created for the use of man."*

Every thing, indeed, connected with the dog, proves the truth of this conclusion of the heathen orator. The dog prefers the society of man to that of his own species; he rapidly improves under human tuition; the species, in his domesticated state, has passed into distinct varieties, differing greatly from each other in their powers and instincts, but all endowed with faculties useful to man, and occupying positions to which their faculties are especially adapted. The experience of Mr Burchell, during his travels in Africa, afforded him an opportunity of judging of the utility of these peculiarities in different varieties, and he thus expresses himself "Our pack of dogs consisted of about five-and-twenty, of various sorts and sizes. This variety, though not altogether intentional, as I was obliged to take any that could be procured, was of the greatest service on

* Canum vero tam fida custodia, tamque amans dominorum adulatio, tamque odium in externos, et tam incredibilis ad investigandum sagacitas ra-ium, tanta alacritas in venando, quid significat aliud, nisi se ad hominum commoditates esse generatos.—CICERO, *De Natura Deorum*.

such an expedition, as I observed that some gave notice of danger in one way, and others in another. Some were more disposed to watch against men, and others against wild beasts; some discovered an enemy by their quickness of hearing, others by that of scent; some were useful for speed in pursuing game; some for their vigilance and barking, and others for their courage in keeping ferocious animals at bay. No circumstance could render the value and fidelity of these animals so conspicuous and sensible as a journey through regions, which, abounding in wild beasts of almost every class, gave continual opportunities of witnessing the strong contrast in their habits between the ferocious beasts of prey which fly at the approach of man, and these kind, but too often injured, companions of the human race."

But it is the shepherd's dog which at present claims our particular attention. This variety is, indeed, one of the most remarkable of the whole tribe, for its fidelity and intelligence. He is easily trained to know the nature and extent of his sphere of duty; he perfectly understands all the ordinary commands of his master, and with admirable sagacity, united to the most unwearied industry and perseverance, he executes them.

The Ettrick Shepherd has recorded some instances of the peculiar faculties and habits of the shepherd's dog, in which he unites the advantage of experience with happy powers of description; and I cannot better illustrate the extraordinary adaptation of this interesting animal to the service of man, than by selecting one or two of his examples.

"My dog Sirrah was, beyond all comparison, the best dog I ever saw. He was of a surly and unsocial temper; disdaining all flattery, he refused to be caressed; but his attention to my commands and interests will never again perhaps be equalled by any of the canine race. When I first saw him, a drover was leading him by a rope. He was both lean and hungry, and far from being a beautiful animal." "He was scarcely a year old, and

knew so little of herding, that he had never turned a sheep in his life; but, as soon as he discovered that it was his duty to do so, and that it obliged me, I can never forget with what anxiety and eagerness he learned his several evolutions. He would try every way deliberately, till he found out what I wanted him to do; and when I once made him understand a direction, he never forgot or mistook it again. Well as I knew him, he often astonished me; for, when hard pressed in accomplishing the task that he was put to, he had expedients of the moment that bespoke a great share of the reasoning faculty."*

One of Mr Hogg's anecdotes of this favourite dog's exploits, I may shortly state.—About 700 lambs, which Mr Hogg had under his care at weaning time, broke off at midnight, in three divisions, to the neighbouring hills. The night was dark, but the faithful Sirrah, though unseen, was at hand, and, hearing his master lamenting the disaster, set silently off in search of the recreant flock. Hogg and a companion searched all night for the runaways, but in vain; and in the morning were under the necessity of returning to relate the disaster to their owner. On their way home, however, they discovered a lot of lambs at the bottom of a deep ravine, called the Flesh Cleuch, and the indefatigable Sirrah standing in front of them, looking round for assistance. "What was our astonishment," says he, "when we discovered that not one lamb of the whole flock was wanting! How he had got all the divisions collected in the dark, is beyond my comprehension. The charge was left entirely to himself from midnight to the rising sun; and if all the shepherds in the Forest had been there to have assisted him, they could not have effected it with greater propriety. All that I can further say is, that I never felt so grateful to any creature under the sun, as I did to my honest Sirrah that morning."†

In another part of his work, Mr Hogg relates an anec-

* Hogg's Shepherd's Calendar. † Ibid.

dote of a dog belonging to a butcher, in the town of Peebles, of the name of Steel, which indicates a degree of fidelity and attachment to his master's interests, remarkable above any thing I have seen elsewhere recorded of this animal, exhibiting these qualities as even superior to bodily pain, and the most pressing calls of the strongest of the natural instincts. Mr Steel was accustomed to commit droves which he purchased, to the charge of this dog, which happened to be a female, and he had a pride in trusting to her prowess and sagacity in driving them unaided to his home. One day he chanced to place a drove under the conduct of his dog, at a place called Willenslee, which is five miles from Peebles, over wild hills, where there is no regularly defined path. The poor dog was heavy with pup, a circumstance to which Mr Steel had not adverted. She was taken in travail on the road, and thus was detained some time later than was expected. Steel, on returning home in the evening, finding she had not made her appearance, was on the point of setting out in search of her and her charge, "but, on his going out to the street, there was she coming with the drove, not one missing; and, marvellous to relate, she was carrying a pup in her mouth! How the poor beast had contrived to manage the drove, in her state of suffering, is beyond human calculation; for her road lay through sheep the whole way. Her master's heart smote him when he saw what she had suffered and effected; but she was nothing daunted; and, having deposited her young one in a place of safety, she again set out full speed to the hills, and brought another and another, till she removed her whole litter, one by one; but the last one was dead."

It would be endless to relate all the instances of extraordinary sagacity in the shepherd's dog, which have been recorded; and I shall close this paper with an anecdote related by Captain Brown, I know not on what authority, which indicates a degree of reasoning, and disinterested kindness, not certainly superior to what we

have already mentioned, yet of a different and not less interesting kind:—"A shepherd on the Grampian mountains, having left his child at the foot of a hill, was soon enveloped in mist; and, unable to return to the precise place, he could not discover the child. In vain he searched for it in the midst of the mist, not knowing whether he went; and, when at length, the moon shone clearly, he found himself at his cottage, and far from the hill. He searched in vain next day, with a band of shepherds.

"On returning to the cottage, he found that his dog, on receiving a piece of oat-cake, had instantly gone off. He renewed the search in vain next day, and again found on his return that the dog had disappeared during the interval, taking with it a piece of cake. Struck with this circumstance, he resolved to watch the motions of his dog, and, when it again came for its piece of cake, he followed it. The dog led the way to a cataract, at some distance from the place where the shepherd had left the child. The banks of the waterfall almost joined at the top, yet separated by an abyss of immense depth, presenting that abrupt appearance which so often astonishes and appals the traveller amidst the Grampian mountains. Down one of these rugged and almost perpendicular descents the dog began, without hesitation, to make his way, and at last disappeared in a cave, the mouth of which was almost on a level with the torrent. The shepherd with difficulty followed; but, on entering the cave, what were his emotions, when he beheld his infant eating with much satisfaction the cake which the dog had just brought him, while the faithful animal stood by, eyeing his young charge with the utmost complacence. From the situation in which the child was found, it appears that he had wandered to the brink of the precipice, and either fallen or scrambled down, till he reached the cave, which the dread of the torrent had afterwards prevented him from quitting. The dog, by means of his scent, had traced him to the spot, and afterwards prevented him from starving by giving up to

him his own daily allowance. He appears never to have quitted the child, except when he went for its food, and then he was seen running at full speed to and from the cottage."*

Many anecdotes, perhaps none quite so wonderful as those I have selected, but sufficiently marked to show that the dog has not only the kindliest affections, but an intelligence and power of reasoning far superior to mere instinct, must occur to the recollection of every reader; and who can think of these without coming to the same pious conclusion with Cicero, that the dog was "created for the use of man."

ELEVENTH WEEK—TUESDAY.

RUMINATING QUADRUPEDS.—THE COW.

The cow is among the most useful, the most generally diffused, the most various in kind, and the longest domesticated of quadrupeds. Man may be said to be more dependant on this race than on any other which the Creator has in his wisdom called into existence; and the readiness with which it accommodates itself to the nature of its food, and increases or diminishes in size, according to the plenty or scarcity of the pasture, and the circumstances of climate, is an obvious indication of benevolent accommodation to the varied localities in which the human family, whose habitation it was destined to accompany, were to be found.

The races of cattle, as we find them domesticated in Europe, differ from each other more in size than in any other particular; but when we pass into warmer climates, a change takes place which would almost make us believe that we were contemplating a distinct species. Instead of the straight back, the square-turned head, the small ears, and the short muscular limbs of our cattle,

* Brown's Anecdotes of the Animal Kingdom, p. 255.

the Indian ox, or Brahmin bull, as it is commonly called, is distinguished by a more elongated form of skull, with a decidedly concave line of profile, an arched neck, a hump of fatty substance rising from the withers, an arched back, sinking and rounded off on the crupper, an enormous dewlap, hanging down in folds, long pendulous ears, and limbs long and taper. This race, of which numerous breeds occur, varying in size from that of a large mastiff to that of a full-grown buffalo, is spread, more or less extensively, over the whole of southern Asia, the islands of the Indian Archipelago, and the eastern coast of Africa, from Abyssinia to the Cape of Good Hope. In all these countries, the zebu (for so is the humped variety termed), supplies the place of the cow, both as a beast of burden and an article of food and domestic economy. In some parts of India, it executes the part of a horse also, being either saddled and ridden, or harnessed in a carriage, and performing, in this manner, journeys of considerable length with tolerable celerity.*

It is the same race which Goldsmith describes under the name of bison, and of one of whose breeds, domesticated by the Hottentots, he gives the following interesting account:—"They are their fellow-domestics, the companions of their pleasures and fatigues: the cow is at once the Hottentot's protector and servant; assists him in attending his flocks, and guarding them against every invader. While the sheep are grazing, the faithful backely, as this kind of cow is called, stands or grazes beside them; still, however, attentive to the looks of its master, the backely flies round the field, herds in the sheep that are straying, obliges them to keep within proper limits, and shows no mercy to robbers, or even strangers, who attempt to plunder. But it is not the plunderers of the flock alone, but even the enemies of the nation, that these backelies are taught to combat. Every army of Hottentots is furnished with a proper

* The Gardens Delineated.

herd of these, which are let loose against the enemy, when the occasion is most convenient. Being thus sent forward, they overturn all before them; they strike every opposer down with their horns, and trample upon him with their feet, and thus often procure their masters an easy victory, even before they have attempted to strike a blow.* An animal so serviceable, it may be supposed, is not without its reward. The backely lives in the same cottage with its master, and, by long habit, gains an affection for him; and, in proportion as the man approaches to the brute, so the brute seems to attain even to some share of human sagacity. The Hottentot and his backely thus mutually assist each other; and, when the latter happens to die, a new one is chosen to succeed him, by a council of the old men of the village. The new backely is then joined by one of the veterans of his own kind, from whom he learns his art, becomes social and diligent, and is taken for life into human friendship and protection."†

There is an air of romance in this account, for which perhaps some allowance should be made; but that the bison is in some respects more active and intelligent than our domestic cow, may easily be conceived,—the training of the latter being of a kind to render its faculties more obtuse, rather than to sharpen them. It is well known that the Indian breed is more expert and docile than ours. Many of them, when they carry burdens, bend their knees to take them up or set them down. They are treated by the natives with a degree of tenderness and care equal to their utility; and the respect for them in India has even degenerated into blind adoration.

* It may be doubted whether or not the backely is *trained* to the combat, although used in the way described. The Irish rebels were in the habit of employing cattle in the same manner, with considerable effect, against the King's troops. Having driven the infuriated herds, with violence, and much shouting, against the approaching troops, they sometimes succeeded in breaking the best disciplined ranks, and thus prepared for an advantageous onset.

† Animated Nature, vol. i. p. 532.

In turning again to the European breed, we find the most remarkable differences arising solely from difference of pasture. Among the Eluth Tartars, for example, where the pastures are remarkably rich and nourishing, the cow rises to the height of seven or eight feet; in the mountainous districts of France, on the contrary, where it is stinted in its sustenance, and driven from the most nourishing pastures, it is dwarfish and degenerated, proving that it is food, rather than climate, which encourages the growth of this animal.

Of all animals, except man, the cow is, perhaps, most extensively propagated. Its nature is equally capable of sustaining the rigours of heat and cold;—of inhabiting the frozen fields of Iceland, as well as the burning deserts of Lybia. It seems, in some of its forms, an ancient inmate in every climate,—domestic or tame in those countries which have been civilized,—savage and wild in the countries which are less peopled; but capable of being made useful in all; able to defend itself, in a state of nature, from its enemies of the forest, and only subordinate to man, for whose comfort it was formed, and to whose dominion it readily yields. The wild animals preserve their nature and their form with inflexible perseverance; but this, and other creatures which have acquired the title of domestic, suit themselves with astonishing facility to the appetites and conveniences of man, changing their dispositions and instincts, as well as their shape, so as to be accommodated to the peculiar locality in which he is placed, and to be subservient in all situations to his use.

I need not enumerate all the blessings which the Creator has bestowed on man in the possession of this useful quadruped. Every one is acquainted with the patient labour of the ox, and knows that the female supplies him with a delicious beverage, which, when prepared in the form of butter and cheese, furnishes agreeable varieties to the luxuries of his table; and that, when the animal is killed, its flesh affords him substantial and accept-

able food, and its hide contributes in various ways to his service in the form of leather, while its very bones are ground down to manure and fertilize his fields.

ELEVENTH WEEK—WEDNESDAY.

THICK-SKINNED QUADRUPEDS.—THE HOG.

The domestic animals which yet remain to be noticed, are those of the order *Pachydermata*, so called from the thickness of their skins. This order consists of several *genera*, differing from each other in various marked particulars; but of these there are only three which deserve to be ranked among domesticated animals, namely, the hog, the horse, and the elephant.

The domestic hog is the descendant of a race still wild in the larger forests of Europe, Asia, and the northern parts of Africa. The wild race is easily reclaimed; but is distinguished from the domesticated breed by its colour, which is a dark grizzled brown; by its greater length of limb; its small ears, and the greater development of its snout.

In his native forest the wild boar is a most formidable animal; and, although he does not court the combat, yet, when hard beset, he defends himself with the most determined energy,—his strength and tusks rendering him a terrific opponent. This animal, in his wild state, can properly be called neither solitary nor gregarious. The three first years the whole litter follows the sow, and the family lives in a herd together. They are then called beasts of company, and unite their common forces against the invasions of the wolf, and the other formidable animals of prey. Upon this, their principal safety, while young, depends; for, when attacked, they afford mutual assistance, calling to each other with a very loud and fierce note. The strongest face the danger; they

form a ring, and the weakest fall into the centre. In this position few ravenous beasts dare venture to attack them. When the wild boar, however, has arrived at a state of maturity, and has become conscious of his superior strength, he then ranges the forest fearless and alone. At this period of his existence he dreads no single creature, nor does he turns out of his way even for man himself.

I have already noticed the peculiarity in the form of the hog's snout, obviously contrived to constitute an instrument corresponding to its instincts in the selection of food in its wild state. When tamed, the animal was intended to occupy, in the domestic economy, the useful station of a consumer of all manner of offal and garbage; and, for this purpose, it is furnished with a most accommodating taste, and powerful stomach. The reader will probably be, therefore, surprised to learn, that this grossly and indiscriminately feeding animal, is in its natural forests rather remarkable for an opposite tendency. The truth is, however, that it is of all quadrupeds, in its wild state, the most select in its choice of its vegetable food. The cow, for example, according to Linnæus, eats 276 plants, and rejects 218; the goat eats 449, and rejects 126; the sheep eats 387, and rejects 212; but the hog eats but seventy-two, and rejects all the rest. It is true that it does not refuse animal food, even in a putrescent state, when it happens to come in its way; but it does not seek for it, and seems rather to devour it from necessity than from preference; and where food is abundant it becomes quite dainty in its choice. In the orchards of peach trees in North America, where the hog has plenty of delicious food, it is said that it will reject the fruit that has lain but a few hours on the ground, and patiently wait whole hours for a fresh windfall.

The hog is the most prolific of the domesticated quadrupeds, unless we include the rabbit in that number. These animals live and multiply in every climate of the

world, with the exception of the polar regions. They are capable of reproduction at nine months old, and their natural life extends to fifteen or twenty years. The production of fifteen or twenty in a litter is not unfrequent, and instances have been known in which double that number has been produced. The celebrated Vauban has made a calculation of the probable production of an ordinary sow and her progeny, during the space of ten generations. After making every reasonable allowance, estimating the ordinary average of a litter so low as six, and even excluding the males, the result is, that the product of a single sow, in that period, will be six millions, four hundred and thirty-four thousand, eight hundred and thirty-eight pigs. Taking it, however, in round numbers, at six millions, we have a produce nearly equal to the whole number existing in France. "Were we to extend our observations," says this naturalist, "to the twelfth generation, we should find as great a number to result, as all Europe would be capable of supporting; and, were they to be continued to the sixteenth, as great a number would result as would be adequate to the abundant peopling of the globe." A remarkable instance of this animal's fecundity, occurred in Leicestershire, where a sow, belonging to Mr Thomas Richdale, Kigworth, had, in the year 1797, produced three hundred and fifty-five pigs, in twenty litters. The editor, who states these facts in a note to Goldsmith's Animated Nature, mentions, at the same time, an instance of a sow, bred near Donaghadee, which, in the course of nine months, brought its owner, by its produce, within a few shillings of £80 of profit.

The remarkable fecundity of this animal, the nutritious nature of its flesh, in temperate climates, and the ease with which it is reared and fed, point it out as a valuable possession for the lower classes. Let the consumption be what it may, there will always be an ample supply for the demand. In the country, there are few families that cannot rear at least one pig every year, and

thus obtain a cheap and nutritious diet, not to mention the profit arising from the lard, fat, &c. of the animal. Or, if the peasantry are too poor to raise a pig for their own subsistence, they can at least, by its sale, procure a sufficient sum to enable them to pay their house-rent, and even, in addition, to purchase some necessaries; and, in fact, in very many of our rural districts, this is the manner in which the labouring poor contrive to keep the family roof over their heads. The hog is, indeed, peculiarly and emphatically the poor man's domestic animal.

ELEVENTH WEEK—THURSDAY.

THICK-SKINNED QUADRUPEDS.—THE HORSE AND THE ASS.

Dr Maccullogh, in proving that certain animals were distinctly created for the use of man, particularizes, among others, the horse and the ass; and his observations on these well known animals are so appropriate, that I need do little more than quote his words. After speaking of the camel, which is only known as the servant and follower of man, which kneels to be loaded without instruction, and which has a provision in its knees and breast for that purpose; he thus proceeds:—

"In spite of much research and much contest, the wild and original state of the horse is equally unknown. I quote the most recent and sober opinions, divested of all views of the present nature, in saying that this animal is nowhere wild at this day, except where it appears to have escaped from the domestic state. Was it ever so, any more than the camel? It is more widely necessary to man, and equally adapted to its wants. I know not why it should not have been created with and for him,—essentially domestic, his appointed servant. On what grounds is the reverse determined? Men commence by forming an opinion, and are somewhat surprised when asked to assign the reasons; yet it is thus

that knowledge is obstructed, and truth becomes unattainable. Were it otherwise, the present argument would not lose a grain in weight, when the temper, dispositions, form, powers, every thing, of this first of all quadrupeds is considered, with their perfect adaptation to the uses which are derived from it. * Its back is that which man would have made for his own use, had he constructed it; the mouth is almost the only one which bears the bit without suffering; it has the only foot (if I except its congeners), which will endure an additional weight under rapid motion; it is the only wild animal, of similar power, which is tamed in a few hours; and nothing but an appointed instinct could have thus taught it to submit, and even to rejoice in its rider. How easily it is attached to man, and to human society, I need not say. But the proofs must not be sought for in our own country, where men are not satisfied unless they gain, by severity and force, that which would be voluntarily and cheerfully given to kindness."*

To this pointed and comprehensive description I may add, that the horse, like other domestic animals, is capable of having his faculties improved by the skill of man, an adaptation doubtless intended for a benevolent purpose, although not always worthily employed. Is swiftness the object? an animal is produced that rivals the wind:† Is it strength that we require? look at the English dray-horse,‡ which is only excelled in its powers by the elephant: Do we seek for endurance of fatigue? the Toorkomans will furnish an example, whose cavalry are trained to advance and retreat at the rate of a hundred miles a-day.§ The size, the quality,

* Attributes of God, vol. iii. p. 131.

† The race-horse Childers ran at the rate of nearly a mile in the minute, or forty-nine feet in a second.

‡ On Surrey Iron Railway, a horse dragged fifty-five tons, walking at the rate of four miles in the hour.

§ This account is given by Sir John Malcolm; and he adds, "When I was in Persia in 1800, a horseman mounted on a Toorkoman horse, brought a packet of letters from Shiraz to Zeherary, which is a distance of five hundred miles, within six days.

the docility, are all suited to every locality and occasion, which man finds necessary for his use, from the Shetland pony to the British race-horse and courser.*

I shall conclude this slight sketch of the horse with the well-known and highly poetical description of the war-horse, contained in the book of Job.

"The glory of his nostrils is terrible: he paweth in the valley, and rejoiceth in his strength: he goeth on to meet the armed men: he mocketh at fear, and is not affrighted; neither turneth he back from the sword. The quiver rattleth against him, the glittering spear, and the shield. He swalloweth the ground with fierceness and rage; neither believeth he that it is the sound of the trumpet. He saith among the trumpets 'Ha, ha;' and he smelleth the battle afar off, the thunder of the captains and the shouting."†

Of the ass, a kindred animal, Dr Macculloch justly observes, that, through a precision of footing which is even augmented in the mule, it is fitted almost like the

* The horse, though not naturally inclined to swim, will sometimes make remarkable efforts in this way. A few years ago, a gentleman residing in the neighbourhood of Dumfries, in riding at night along the shore from Skinburness to Bowness, on the Cumberland coast, mistook his way in passing a creek, being deceived by a light on the Scotch side. His horse carried him directly across the Solway Frith, and he landed at Newby, not far from Annan. The distance is fully two miles, but the horse did not perhaps swim more than a third part of that way, the tide being low. A much more remarkable feat is described by M. de Pages, in his Travels round the World, and confirmed by Sparman, of a horse which saved some seamen ready to perish in a wreck off the Cape of Good Hope. "The sea ran dreadfully high, and broke over the sailors with such amazing fury, that no boat whatever could venture off to their assistance. Meanwhile a planter determined to make a desperate effort for their deliverance. He alighted, and blew a little brandy into his horse's nostrils, and again seating himself in the saddle, he instantly pushed into the midst of the breakers. At first both disappeared, but it was not long before they floated on the surface, and swam up to the wreck; when, taking with him two men, each of whom held by one of his boots, he brought them safe to shore. This perilous expedition he repeated no seldomer than seven times, and saved fourteen lives; but on his return the eighth time, his horse being much fatigued, and meeting a most formidable wave, lost his balance, and was overwhelmed in a moment. The horse swam safely to land, but his gallant rider was no more."

† Job xxxix. 20-25.

goat, for those mountain difficulties, where the horse becomes less serviceable; while its strength, patience, steadiness, and indurance of privation in food, form a combination of qualities, that point to the design, which allotted it as another servant to man.

From time immemorial, the ass, in eastern climes, has been the slave of man; but, in the latitudes of Europe, its introduction may be considered as comparatively recent, being unknown there in the time of Aristotle. It seems, indeed, to be more adapted to the hill country of more southern climates, and especially of the East. In Europe, it is dull, slow, and diminutive in size. In more genial regions, it is large, handsome, and spirited. It is, therefore, frequently used among the Orientals, even at this day, in preference to the horse; and, in ancient times, it was there held in still greater estimation than at present. It will not be forgotten, that when our Lord made his triumphant entry into Jerusalem, he was mounted on an ass's colt.

In considering the subject of domestic animals, we must not forget, that the advantage is not altogether on the side of man. It is an additional proof of Divine benevolence in this arrangement, that the benefit is reciprocal, and that the services bestowed upon us, are requited in our attentions towards them. By cultivation, we increase the quantity of food, not only for ourselves, but for the creatures whose aid we require; and, by thus augmenting the number of living beings, augment the sum of enjoyment. The chief happiness of the lower animals consists in an ample supply of food; and this, man bestows. He protects his herds and flocks from their numerous enemies; for their sakes, destroying the beasts of prey, or affording means of defence which they are themselves incapable of employing. Let any person compare the state of the sheep, the goat, the ox, and the horse, under the protection of man, with the privations and dangers they would have to endure, if left to range at large in the uncultivated forest, and he will at once

perceive that their domestication must be considered as a blessing, not more with reference to man, than with reference to themselves.

It is true that there are some evils to be placed in the opposite scale, but these are light in comparison with the advantages. Sometimes a cruel master may overload or overwork his horse or his ox; but the check upon his cruelty is found in his selfishness; for he can never injure his servant without at the same time inflicting punishment on himself; and a kind Providence limits the sufferings of the brute creation to the moment, happily withholding from them, what so peculiarly imbitters the lot of man, the recollection of evils that are past, and the anticipation of evils to come. They are slain for our use; but, even here, there is a beneficent provision; for, as death must come, it is well that it arrives with little pain, and, after a state of enjoyment from ample feeding; rather than that the animal should die of famine, or of the infirmities of age, or be torn to pieces by wild beasts. The death of one animal, too, affords place for the subsistence of another full of vigour, and, buoyant with youthful enjoyment; so that here also the sum of happiness is increased.

ELEVENTH WEEK—THURSDAY.

THICK-SKINNED QUADRUPEDS.—THE ELEPHANT.

The elephant, which is the last example of the lower animals I shall notice, may rather be said to be a tamed than a domestic animal. It is seldom reared from the birth in those countries where it is employed for the use of man, as it is found more advantageous to obtain it in its wild state, when already some years old. The possibility, indeed, of raising it in a domestic state was long doubted, but this is now found to be a prejudice connected with some superstitious notions.

The elephant is the largest animal which now treads the surface of our globe, although it dwindles to a pigmy when compared with some of the inhabitants of the earth, in a primeval period. There are peculiarities in its form, which exhibit a remarkable adaptation to its enormous bulk. Among these has been noticed the formation of its legs, which differ from those of all other animals, in being strong and massive pillars, evidently framed with admirable mechanical skill for sustaining an immense weight. But the most remarkable contrivances for counteracting the inconvenience arising from gravity, are to be found in the neck and proboscis. The head, itself large, contains two heavy tusks, and the weight could not be conveniently borne at the end of a long neck; besides that the animal was to be formed with the power of raising immense weights with this portion of its body. The neck is therefore formed comparatively very short, so that it will not admit of the mouth reaching the ground to feed. But, to counterbalance this defect, and also to overcome the difficulty arising from the tusks, the elephant is provided with an instrument of admirable structure, in its proboscis or trunk, which has been thus described:—It is composed entirely of bundles of muscular fibres enclosing two canals. By their contraction or relaxation, these muscles are capable of drawing up, shooting out, or twisting in any direction, the organ which they compose: indeed, the pliability and power it possesses may, in some degree, be conceived from the account of Cuvier, who has ascertained that the number of distinct muscles, each having its distinct action, is not far short of forty thousand. Hence that union of strength and precision, force and address, which this exquisite piece of mechanism exhibits, and which so well proclaims the wisdom and skill of the Great Designer. The canals of the proboscis are for the purpose of drawing up any liquid, which is afterwards discharged into the throat, or over the body at pleasure. They are in fact two self-acting syringes. The proboscis itself is terminated with

a flexible instrument, called a finger, which serves a purpose not unlike the human finger, as, by pressing against the division between the two canals, it can hold any small object with the greatest facility. With this little instrument, it can even pick up a pin; and hence this noble animal is endowed with the faculty, almost peculiar, except in this instance, to man, of examining objects with precision by the touch, which, in conjunction with its native intelligence, has ranked it as the first of quadrupeds, even when judged of by a more honourable criterion than that of bulk.

The first and most essential property of the trunk is to supply the animal with food; for, with this, it can despoil the trees of their young shoots and leaves, overturn the mimosa trees, that it may feed on their succulent roots, and crop the herbage of the fields. But it also employs this instrument in various other ways, as occasion requires, especially when employed in the service of man. It rarely, however, uses it as a weapon of offence, seeming sensible of its value, and carefully preserving it from injury.

The average height of the elephant is nine or ten feet, though it frequently rises as high as fifteen feet. Its weight varies from four to nine thousand pounds. When tamed, it becomes the most gentle, obedient, and affectionate of domestic animals, capable of being trained to any service necessary in those warm countries of which it is a native.

Only two species of the elephant at present exist, the Asiatic and African; but the remains of several extinct species are met with in almost every part of the world, particularly in Asiatic Russia.

Elephants hold undisputed sway in the mighty forests which they inhabit; their immense size, united strength, and great swiftness, enabling them to dislodge all intruders on their abode. The lion and tiger avoid such formidable assailants, and leave them in undisputed possession of their forest. Seemingly sensible of the large

supply of food which they require, they will allow no animal, however peaceable, to browse in their territories, of which they hold exclusive possession; and they can only exist in those extensive woody ranges, or immense plains, where vegetation abounds in all its wild luxuriance.

The strength of the elephant, conjoined with its sagacity, renders it a most efficient servant, where extraordinary animal force is required, as in dragging ships, heavy stores, and ordnance. Captain Williamson observes, that many of our most arduous military operations have been greatly indebted for their success to the sagacity, patience, and exertion of the elephant; and states, in particular, that, "when cannon require to be extricated from sloughs, the elephant, placing his forehead on the muzzle, which, when limbered, is the rear of the piece, with an energy scarcely to be conceived, will urge it through a bog, from which hundreds of oxen or horses could not drag it. At other times, lapping his trunk round the cannon, he will lift while the cattle and men pull forwards."

The quickness of comprehension displayed by this noble animal, has justly procured for him the appellation of the "half reasoning elephant." "I have myself," says an officer who served in India, "seen the wife of a *mohaut* (for the followers often take their families with them to the camp), give a baby in charge to an elephant, while she went on some business, and have been highly amused in observing the sagacity and care of the unwieldy nurse." In corroboration of this statement, I may notice the curious fact mentioned in the "Philosophical Transactions," of the attachment of an elephant to an infant. He was said never to have been happy except when the infant was near him. The nurse, therefore, frequently took the child in its cradle, and placed the latter between his feet. He at last refused to eat his meat when the infant was absent. When it was asleep, he watched it with much solicitude, and drove

off the flies with his trunk as they approached. If it awoke and cried, he would rock the cradle, till it again fell asleep.

A thousand well authenticated accounts of the sagacity, the docility, the quick sense of injury, and the affectionate disposition of the elephant are stated, from which I shall only select one well known example, that is at once characteristic of almost all these qualities. "Some years ago, an elephant at Decan, from a motive of revenge, killed its conductor. The wife of the unfortunate man was witness to the dreadful scene; and in the frenzy of her mental agony, took her two children, and threw them at the feet of the elephant, saying, 'Take my life also, and that of my children!' The elephant becoming instantly calm, seemed to relent; and, as if stung with remorse, took up the eldest boy with his trunk, placed him on its neck, adopted him for its *cornac*, and never afterwards allowed another to occupy that seat."

ELEVENTH WEEK—SATURDAY.

REFLECTIONS ON THE DOMESTIC ANIMALS.

"DEPRIVE man of the ox, the dog, and the horse," says Dr Macculloch, "and he could not maintain his position in the world for a year; he never could have attained the one which he holds, nor could he discover a compensation." He who reflects on the vast importance these animals are to the comfort and convenience of man, and on the addition which they afford to his power, will at once perceive that there is no exaggeration in this assertion. It may be true, that, as society advances in civilization, new modes of acquiring power, and new means of increasing our comforts and conveniences, may be discovered, which shall leave these immediately ac-

cessible gifts of the Creator far behind; but even should the uses of the domestic animals be destined to be superseded or excelled by the inventions of man, in a highly improved state, who will venture to say, that they were not necessary to assist him in arriving at that state?

And let it not be said, that the properties of these animals have been only accidentally fitted for the use of man, and that he is entirely indebted to his own ingenuity, in the appropriation of instincts and faculties destined by nature solely for a different purpose,—for the existence or the happiness of the animal itself. This view may be disproved, and indeed I think I may confidently say, has already been disproved, by reference to the nature of these instincts and faculties, and, it may be added, by reference to the very form and bodily structure of the creatures we have subjugated. That the horse is made for a rider, and the ox for patient endurance of fatigue, and the dog for a thousand little offices, which contribute to the comfort of man, no person who candidly considers the correspondence of their forms with the nature of their faculties, and the correspondence of these, again, with the wants of the human race, can, without a most inveterate and perverse scepticism, allow himself for a moment to doubt.

One very remarkable fact, which has already come under our notice, in regard to the subject of domestication, is the effect which an intercourse of the lower animals with man for many generations produces, in changing their habits, their dispositions, their very bodily form, fitting them more perfectly for the supply of his various necessities. This is particularly the case with those that have been the longest reclaimed, and are the most needful to him. How numerous and useful are the varieties, for example, which we find in the dog and the horse! And what adds materially to the proof of Creative Design, in this instance, is the power which man possesses of improving the breeds, or rendering them more subservient to some particular uses. The sheep

has been made to yield a finer fleece, the cow to give a more abundant supply of milk, the horse to become more fleet and powerful, the dog more sagacious, under the skill of man. This is one species of the rewards which the Supreme Governor, in pursuance of a very general principle employed by his paternal beneficence, has annexed to human industry and ingenuity,—a department of useful discipline in the school of Providence. It is essential to man's welfare, that his faculties shall be stimulated, and kept in constant exercise; and, in a thousand ways, arrangements have been made by the Creator to effect this important purpose.

Another observation, which cannot fail to strike the minds of those who study the subject of domestication, relates to the dispositions implanted in the various animals which are the objects of it. These dispositions were clearly bestowed for the purpose of rendering them fit for this state, whether we consider, in some species, their affections, which go forth towards man as their protector and benefactor; or, in others, their love of ease, which induces them to submit without resistance to his sway; or in others, again, their local attachments, which bind them to the place in which they have been brought up; or, finally, in others still, their very stupidity, which proves them to be born for a state of slavery.

Of the first of these qualities,—that of affection for man,—what an admirable example do we find in the dog! It is the instinct, not of individual varieties only, but of an entire race; while in these varieties we observe shades of difference, which show that the faculty is bestowed with discrimination, and with peculiar reference to man's convenience or comfort. In the elephant, too, a similar amiable property is conspicuous; and, in both orders, this remarkable propensity bears no necessary reference to feeding, or marks of regard, on the part of the master; but is free, disinterested, and noble. In other tame animals, preferences to their

keepers also exist; but, while these may be equally regarded as an intended character of the inferior creation for the benefit of man, they are in general of a less generous character. Some very affecting stories are related of the deep and ardent affections of both the animals I have mentioned, which cannot be heard without emotion. We read of elephants who have defended their masters with their lives, when fallen in battle;* and we are told of dogs who have taken their station on the grave of some human friend, refusing food with the most steady resolution, till they pined to death; and of others who, during the absence of their master, became dejected and cheerless, and, on his sudden return, expired for joy.† The attachment of some of the monkey tribe to those who show them kindness, is remarkable. I was myself once possessed of a monkey, of one of the smallest species, which was frequently permitted to leave its cage, and run about the grounds. Whenever he observed me at a distance, he used instantly to rush towards me, uttering cries of delight, and, if permitted, would fondly clasp his arms round my knee, or take hold of my hand and squeeze it with both his in the most affectionate manner, applying, at the same time, his lips to the back of my hand, with a motion so like that of a human being, when expressing humble but devoted attachment, as to be at once humiliating and affecting.

The instinct of local attachment is another of those

* It is said of one of the soldiers of Pyrrhus, king of Epirus, that, when fighting in the territory of Argos, he fell wounded from his elephant, that noble animal rushed furiously among the combatants till he found his master, when he raised him gently from the ground with his trunk, and placing him on his tusks, carried him back to the town; and when King Porus, in a battle with Alexander the Great, met with a similar misfortune, his faithful elephant is said to have kept the enemy at bay till he had replaced the monarch on his back with his trunk; but the poor animal lost his life in this heroic defence.

† This is related of a dog belonging to the Marquis Langallery, and of several others. In the Life of Mary Queen of Scots, it is stated that her favourite lap-dog, which had followed her to the scaffold, would not leave the body till forced away, and died two days afterwards of a broken heart.

qualities by which the domestic tribes become subdued to the service of man. His home becomes theirs, and thus a bond of union is created, of a very strong and important kind. This instinct of home, indeed, belongs to wild animals as well as tame, and is one of the means by which the Creator has secured the useful distribution of animals, and their limitation to their proper boundaries; but it is of great moment also in domestication, and, though beneficial in a different way, may surely be ranked among the properties intended for the purpose which it serves. Proofs of the strength of this principle are of daily occurrence. It is seen in the astonishing efforts which some animals make to return to the locality in which they have been reared, and the mysterious manner in which they find their way by unknown roads; and it is observed on a large scale, in the return of the migratory animals to the place of their birth, after wanderings of thousands of miles. The very same principle attaches the horse to its manger, the goose to its roost, and the sheep to its native hills.

This subject could easily be pursued further, and it might be shown, that, in various other particulars, there is an adaptation among the lower animals to the service of man, both among those which have already been domesticated, and such as remain wild. But it seems unnecessary; and I shall conclude by observing, that there may not improbably be various other tribes of the brute creation, which, at some future period, may be destined to swell the list of animals reclaimed by the art of man, and subservient to his use. Some of the properties I have mentioned, are certainly to be found among various orders which still roam the forest, pointing them out as subjects for an experiment, which, if successful, might confer a reciprocal boon.

TWELFTH WEEK—SUNDAY.

ON THE DESTRUCTION OF THE WORLD, AND THE RENOVATION OF THE HUMAN FRAME IN A FUTURE STATE.

The more that is known of the globe on which we dwell, both as to its internal structure, and the natural processes of decay and reproduction which are continually proceeding on its surface, the more we must be struck with the mysterious nature and inconceivable extent of the changes which it has undergone, is now undergoing, and seems yet destined to undergo. Geology has unfolded to us very many unexpected facts, which all unite to prove that the crust of this planet has frequently been broken up by some mighty catastrophe, which has entirely deranged its materials, while it has submerged and destroyed all the organized existences on its surface. It has also proved, that, after these catastrophes, the One, great Creative Mind, must have exerted *His* amazing and incomprehensible attributes in restoring the formless chaos to beauty, order, and harmony, and in reanimating the wide waste with life and enjoyment; and that, wherever this work of renovation was carried on, the most indelible traces have been left of consummate wisdom and benevolence:—

> Till o'er the wreck emerging from the storm,
> Immortal Nature lifts her changeful form,
> Mounts from her funeral pyre on wings of flame,
> And soars and shines,—another and the same.
>
> DARWIN.

These discoveries seem to prepare us for the arrival, at some future period, of another similar revolution; and, as it appears that each successive catastrophe has indicated continually progressive improvement in the developments of living forms, so as to exhibit a design infinite in its extent, and boundless in its duration, I

cannot but think that we may, in these indications, discover an intimation, by no means obscure, of plans and preparations for the fulfilment of higher destinies, which have for their object the final perfection and happiness of animated beings, but the precise nature of which can only be sought for in the book of revealed truth.

In looking from these indications, that we may prosecute the subject on surer ground, we find, in the record of Divine inspiration, a series of prophecies, declaring that the world, which, since the creation of man, has already been once destroyed by a universal flood, is destined again to be brought to an end; that the day will come, in which "the heavens shall pass away with a great noise, and the elements shall melt with fervent heat, and the earth also, and the works that are therein, shall be burnt up;" but that, after this awful catastrophe, there shall arise "a new heaven and a new earth, wherein dwelleth righteousness."

Some intimations of a very glorious and animating character are afforded us of the nature and glorious intention of this change, as relates to the human race. The dead are to live again. Their immortal souls are, by some mysterious operation, to be re-united to their once mortal bodies; "the sea and the grave are to give up the dead which are in them," while those that are alive, are, "in a moment, in the twinkling of an eye," to be changed:—"And the Son of Man shall sit on the throne of his glory, and all the holy angels with him; and before him shall be gathered all nations, and he shall separate them one from another, as a shepherd divideth the sheep from the goats, and they shall be judged according to the deeds done in the body; the wicked shall go away into everlasting punishment, but the righteous into life eternal."

Something of the nature of the change upon the body, which, at that great and terrible day of the Lord, is to take place, is also intimated. Like seed sown in the ground, it is buried that it may spring up from the in-

sensible germ to a new life. But it is a life altogether different from, and superior to, that of its former state. "It is sown a natural body; it is raised a spiritual body. The first man is of the earth, earthy; the second man is the Lord from heaven. As is the earthy, such are they also that are earthy; and as is the heavenly, such are they also that are heavenly; and as we have," in this world, "borne the image of the earthy, so shall we," in the world to come, "bear the image of the heavenly."

Here a most astonishing change is intimated in the material frame of our bodies, as well as in the condition of our souls. Now, even in the circumstances of this amazing revolution, we may behold some analogy to the ordinary operations of Providence in the material world. This analogy is hinted at by St Paul, in the passage from which I have just quoted. He compares the renovation which is to take place at the resurrection of our bodies to that which occurs to seed when sown. The change of the seed in the earth,—the germ only springing up, and the rest falling into decay,—and the production of a new plant and new grain by the Creative power of the Eternal, are beautifully and instructively compared to the springing up of a new and spiritual body from the germ of the mouldering human body which has been sown in the grave. The circumstances are different, indeed, because the catastrophe is new and unspeakably glorious; yet there is something satisfactory in the analogy, even though it be not perfect.

The reproduction, indeed, of both animal and vegetable life is so mysterious and full of wonders, that whoever contemplates it wisely, will cease to think it "a thing incredible that God should raise the dead." In tracing the development of a plant, with its root striking into the earth, its plume bursting through the ground, its stalk ascending, its leaves and flowers expanding, its fruit forming and ripening; and much more in tracing the development of animal life, from the cicatrice to the

full-grown chick in the egg, and thence, again, till it opens the shell and walks abroad, a living creature fearfully and wonderfully made, we behold a miracle of creative power and wisdom, not less wonderful,—though on a minute scale, and rendered familiar to us by daily observation,—than the resurrection of the human body, and its re-union with the immortal inhabitant of the once mortal tenement.

But what an amazing scene of "glory, honour, and immortality," does the revelation of this mighty event open to our view. It is delightful to dwell upon it, and to trace the history of the Divine counsels with regard to fallen man. When paradise was lost, man was degraded and alienated, but not abandoned. The second Adam came, "holy, harmless, undefiled, and separate from sinners,"—the Godhead united to humanity;—sin was expiated, and life and immortality brought to light. And now it is proclaimed that this mortal shall put on immortality, and this corruptible incorruption, and death shall be swallowed up in victory. What a new and glorious light is thus thrown on the ways of Providence, and the destiny of man! This world is our first and preparatory state:—we are here, as it were, in embryo. The seed, which is vegetating under ground, shall come forth in beauty, and shed its fragrance and its loveliness on the summer breeze; the bird, which is growing in the egg, shall rise into the light of day, and, exulting in its new being, shall soar in the liquid air, and fill the sky with its song of gladness; and thus, also, the redeemed among men shall burst from the womb of earth, and, in their new heavens and new earth, shall rejoice in the perfection and happiness of their nature. "They shall hunger no more, neither thirst any more, neither shall the sun light on them, nor any heat; for the Lamb which is in the midst of the throne shall feed them, and lead them unto living fountains of waters; and God shall wipe away all tears from their eyes."

"Seeing these things are so, what manner of persons

ought we to be, in all holy conversation and godliness?" It is at once astonishing and mortifying to think how little mankind in general are affected by the blessed hope thus set before them, and the unspeakably important considerations connected with it; and I know nothing which more strikingly exhibits the degradation of our moral natures than the preference which is given to the paltry present over the glorious future,—to time over eternity. It argues an obtuseness of perception, a perverseness of inclination, and a meanness of spirit, which marks the depth of our fall, and which irresistibly urges upon us the necessity of seeking for aid from a Higher Power. Nor shall we seek in vain. There is a hearer and an answerer of prayer; there is a Saviour, who ever liveth to make intercession for us; there is a grace which is sufficient for us, and a strength which is made perfect in weakness.

TWELFTH WEEK—MONDAY.

FISHES.

It is not my intention to occupy much time in considering the inhabitants of the sea, which can scarcely be said to be affected materially by the seasons, as they live in an element where the sun exerts his influence less powerfully than either on the dry land or in the air, and where the changes from heat to cold are consequently less sudden. As these species of living beings, however, form a distinct department in the works of the Creator, and do not less remarkably exhibit his perfections than the other orders of the animal kingdom, it would be improper to pass them by, without some notice.

In reviewing the various series of animal existences, we constantly find that the simplest structures and modes of propagation are those belonging to the aquatic

tribes. Among vertebrated animals, the lowest rank is occupied by *Fishes*,—a class comprehending an immense number of species, which are all inhabitants of the water, which exhibit an endless variety of forms, and which open a wide field of interesting research. We cannot fail to perceive, on the most cursory glance, the beautiful adaptation of the form and structure of all these animals to the properties of the element in which they are destined to reside. In order that the fish may glide through the fluid with the least resistance, all its vital organs have been collected into a small compass, and the body has been reduced into the shape of a compact oval, compressed laterally, and tapering to a thin edge both before and behind, for the purpose of readily cleaving the water, as the fish darts forward, and also of obviating the retardation which might arise from the reflux of the water collected behind. With the view to diminish friction as much as possible, the surface of the body has been rendered smooth, and the skin has been impregnated with oil, which, while it lubricates the animal, defends it from injurious impressions, and, at the same time, prevents the water from penetrating into its substance.

The body of a fish is nearly of the same specific gravity as the water which it inhabits, and the effect of gravity is therefore almost counterbalanced by the buoyant force of that fluid. This is not, however, precisely the case, and as the body of a fish is generally a little heavier than the fluid medium, especially if that medium be fresh water, it is necessary for the animal to keep itself in some degree of motion in order to prevent its sinking. But there *is* here a very peculiar structure, which has justly been remarked as one of the most singular instances that is met with of an express contrivance for a specific purpose, and of the employment of an agency of a class different from that of the mechanical powers usually resorted to for effecting the same object. Were the animal to acquire the faculty of alter-

ing at pleasure its specific gravity, it would then possess the means of rising or sinking without calling into action either the fins or the tail. Such is precisely the object of a peculiar mechanism which the Creator has provided in the interior of the body. A large bladder, filled with air, has been placed immediately under the spine, in the middle of the back, and above the centre of gravity. This is known by the name of the *air-bladder*, and is various in its form and structure in different fishes. When distended with air, it renders the whole fish specifically lighter than the surrounding water, and the animal is thus buoyed up, and remains at the surface without any effort of its own. On compressing the bladder by the action of the surrounding muscles, the included air is condensed, the specific gravity of the whole body is increased, and the fish sinks to the bottom. On relaxing the same muscles, the air recovers its former dimensions, and the fish is again rendered buoyant. Dr Roget, after describing this structure, significantly asks, "Can there be stronger evidence of design than the placing of this hydrostatic apparatus, acting upon philosophical principles, in the interior of the organization, for a purpose so definite and unequivocal?"

There is assuredly something exceedingly striking in the peculiarity and admirable simplicity of this contrivance, but the evidence of design is not less complete in other parts of the construction of aquatic animals. Of this kind is the nature of the external mechanism for locomotion. The principal instrument of progression is the tail; for the fins are merely auxiliary organs, serving chiefly to balance the body. A fish moves in the water on the same principle as a boat is impelled in sculling or paddling, by striking rapidly with the tail alternately to the right and left. Every part of the body is calculated to promote the execution of this motion. The principal muscular strength is bestowed on the movements of the tail, and the most powerful muscles are those which give the lateral strokes just mentioned. For the same

purpose the most important intestines are placed forwards, and crowded towards the head. There is no neck; and the abdomen may be considered as immediately adjoining the head, the organs of respiration being placed rather below than behind the latter members. It is thus that scope has been given to the vertebræ connected with the motion of the tail, which compose more than half the bulk of the animal.

The construction above described is so admirably suited for its purpose, that most fishes glide through the water with the utmost rapidity, and with scarcely any visible effort, performing long journeys with no apparent fatigue. The salmon has been known to move at the rate of nearly four hundred miles a day, for many days together. Sharks often follow ships across the Atlantic, not only outstripping them in their swiftest sailing, but playing round them on every side just as if the vessels were at rest.*

Every thing about a fish is peculiar and specially adapted to the element in which it moves,—the mouth, the gills, the fins, the circulation of the blood, the light and elastic gristle of the bones, the various organs of sense; and each in its kind forms a demonstration of consummate wisdom in the Divine Contriver. But I must not pursue the enticing subject further, and shall conclude with a striking passage from Mr Kirby's Bridgewater Treatise, in which he compares the tenants of the water with those of the air.

"When we sum up all the diagnostics of the class we are considering, we can trace at every step, so that almost *he that runs may read*, infinite power in the construction, infinite wisdom in the contrivance and adaptations, and infinite goodness in the end and object of all the various physical laws, and in all the structures and organizations by which they are severally executed, which strike the inquiring mind in this globe of ours. What else could have peopled the water and the air

* Roget's Bridgewater Treatise, vol. i. pp 408, 434.

with a set of beings, so perfectly and beautifully in contrast with each other, as the fishes and the birds? Sprung originally from the same element, they each move, as it were in an ocean of their own, and by the aid of similar, though not the same, means. The grosser element they inhabit required a different set of organs to defend, to propel, and guide, and to sink and elevate the *fish*, from what were requisite to effect the same purposes for the *bird*, which moves in a rarer and purer medium. Yet as both were fluid mediums, consisting of the same elements, though differently combined, analogous organs, though differing in substance, structure, and number, were required. For what difference is there between swimming and flying, except the element in which these motions take place? The fish may be said to fly in the water, and the bird to swim in the air; but perhaps the movements of the aquatic animal, from its greater flexibility and the number of its motive organs, is more graceful and elegant than those of the aerial. The feathers of the one are analogous to the scales of the other; the wings to the pectoral fins; and the tail of both acts the part of a rudder, by which each steers itself through the waves of its own element."*

TWELFTH WEEK—TUESDAY.

MAN.—HIS EXTERNAL STRUCTURE.

CICERO, who not only joined the qualities of a profound philosopher to those of an accomplished orator, but who is entitled to the still higher praise of cherishing, so far as his opportunities admitted, enlightened and deep-felt views of religion in the midst of heathenism and profligacy, gives a striking description of the human body, which, although in the present day, when his statements

* Kirby's Bridgewater Treatise, vol. ii. pp. 375, 376.

have become familiar, it may appear less original and striking than it must have been when first published, proves that he was nobly alive to the wonders of Creative Intelligence. The passage is as follows:—

"To what has been said of the incessant and ingenious foresight with which Nature acts, many things may be added, to show how abundant and how valuable are the bounties which have been bestowed on men by the Deity; who, first of all, has formed them elevated above the earth, lofty and erect, that with an eye directed to heaven, they might aspire to the knowledge of the Divine character.* For men are placed upon earth, not as mere inhabitants and possessors of the soil, but as spectators of spiritual and heavenly things, a power which no other animal possesses.

"With respect to the senses, by which exterior objects are conveyed to the knowledge of the soul; their structure corresponds wonderfully with their destination, and they have their seat in the head, as in a citadel. The eyes, like sentinels, occupy the most elevated place, whence, on discovering objects, they may give the alarm. An eminent station was suitable to the ears, because they are destined to receive sounds, which naturally ascend. The nostrils required a similar situation, because odours likewise ascend, and it was necessary that they should be near the mouth, through which Nature gives a passage to solids and to liquids. As for touch, it is diffused generally over the whole body, that we might neither receive any impression, nor be attacked by cold or heat without feeling it.† * * *

* Ovid expresses the same sentiment in a well-known passage of his Metamorphoses:—

> Pronaque dum spectant animalia cætera terram,
> Os homini sublime dedit: cœlumque tueri
> Jussit, et erectos ad sidera tollere vultus.
>
> *Met. Lib. i. v.* 84.

† The Roman orator here adds a sentence, which, though equally true and striking with the rest, might, if translated, somewhat shock the fastidiousness of modern taste.—"Ut, in ædificiis, architecti avertunt ab oculis

" But what other artist than Nature, whose dexterity is incomparable, could have formed our senses with such exquisite skill? She has covered the eyes with very delicate tunics, transparent before, that we might see through them, and close in their texture, to keep these organs of vision in their proper situation. She has made them smooth and moveable, to enable them to avoid every thing by which they might be injured, and to look with facility to whatever side may be necessary. The pupil, through which the impressions that constitute the faculty of sight are received, is so small, that it readily escapes from every object capable of doing it mischief. The eyelids, which serve as coverings to the eye, have a soft and polished surface, that they may pass over them without pain. Whether the fear of some injury obliges us to shut them, or we choose to open them, the eyelids are formed in such a manner, as to adapt themselves to either of these motions, which is performed instantaneously. They are, if we may so express it, fortified with palisades of hair, which serve to repel whatever would attack the eyes when they are open, and to defend the place where the eyelids join, when sleep has closed them and rendered them of no use to us. Our eyes possess the additional advantage of being surrounded and defended by eminences; for, on the one hand, to stop the perspiration that trickles down from the head and forehead, they have projecting eyebrows; and, on the other, to preserve them from below, they have cheek-bones, which likewise advance a little. The nose is placed between both, like a partition-wall.

" With respect to the ear, it remains continually open, because we have occasion for its services, even when asleep. If any harsh sound then strikes it we are awaked. It has winding channels, lest, if they were straight and level, any object might introduce itself into them.

et naribus dominorum ea, quæ profluentia necessario tetri essent aliquid habitura; sic natura res similes procul amandavit a sensibus."

"And then our hands,—how convenient are they, and how useful to the arts! The fingers are extended or contracted without the least difficulty, so extremely flexible are their joints. With their assistance the hands use the pencil and the chisel;—they play on the lyre and on the lute. So much for the elegant accomplishments; and as to the necessary arts, they cultivate the earth, build houses, manufacture stuffs, make clothes, and utensils of copper and iron. The imagination invents,—the senses examine,—the hand executes.—So that if we are lodged, clothed, and sheltered; if we have cities, walls, habitations, temples, it is to our hands that we are indebted for all these."*

Modern science has greatly increased the force of the Roman orator's reasoning, by its anatomical and philosophical discoveries; for the deeper we penetrate into the secrets of Nature, the more wonderful are the evidences we find of the Divine perfections; but it is pleasing to observe an accomplished mind emerging from surrounding darkness, and employing its enlarged faculties in contemplating, with becoming gratitude, the wisdom and beneficence of the Creator.

The structure of the human body has been a subject of admiration to all who have even cursorily examined it, and nothing seems better calculated to silence atheism, than the labours of the anatomist. The anecdote of the ancient sceptic, on whose mind conviction flashed while examining the construction of the human heel, is well known. In modern times, Nieuwentyt, Ray, Paley, and others, have drawn many unanswerable arguments from this source; and Galen, at a more distant period, in the midst of an anatomical analysis of the human frame, gave vent to his admiration in words, which, though

* De Natura Deorum, lib. ii. Cicero is not singular among the ancients, in adducing the construction of the human body, as a proof of Divine skill. Aristotle, in combating the philosophy of Anaxagoras, says, that man is not superior to the brutes because he has hands, but that he has hands because he is superior to the brutes, and Plato speaks of the structure of the human frame as an evidence of Creative Wisdom.

those of a heathen, would have done honour to the piety of a Christian :—

" O Thou who hast made us! in composing a discourse so sacred, I think I am chanting a hymn to thy glory. I honour thee more by unfolding the beauty of thy works, than by sacrificing to thee whole hecatombs of bulls, or by burning in thy temples the most precious incense. True piety consists in first learning myself to know, and then in teaching others, the greatness of thy bounty, thy power, and thy wisdom. Thy bounty is manifested in the equal distribution of thy presents, having allotted to each man the organs which are necessary for him; thy wisdom is seen in the excellence of thy gifts, and thy power is displayed in the execution of thy designs. "*

TWELFTH WEEK—WEDNESDAY.

MAN.—HIS INTELLECTUAL POWERS.

The mental powers of man are suitable to his physical condition. He has instincts, but these are not equal in the human race to those of the brutes, because he is invested with a higher principle, which supersedes them. In him alone, of all the visible creation, is the faculty of reason fully developed. The lower animals, it is true, possess qualities which approach this high property, and which cannot easily be distinguished from it by a definition; but if it may be called reason, it is not *human* reason. It wants, even in its nearest approaches, the freedom, the comprehensiveness, the grasp of human intellect, although this faculty be in the brute cultivated to its utmost extent, and in the man be suffered to exist without improvement. A dog or an elephant may display a surprising sagacity in one or two directions; but man is endowed with a sagacity of a superior order in all directions. And then, if we speak of his capacity

* Galen de Usu Part. lib. iii. cap. 10.

for improvement, how infinitely superior is he to every other order of the animal creation. Compare a Newton, a Locke, or a Bacon, with a savage of Australia, and the amazing capability of expansion in the human mind will be at once perceived.

This leads me to notice a peculiar intention of the Creator with regard to the human race,—I allude to that of intellectual discipline. Every thing seems to be contrived and adapted to this great object. His situation in reference to the external world, whether we consider animate or inanimate nature, the alternations of the seasons, the germination, the growth, and the decay of plants, the various faculties and dispositions of living beings, and especially the power bestowed on him of appropriating organized as well as unorganized existences to his use, to alter the form or qualities of one class, and to modify the functions and instincts of another, so as to make them subservient to his will and productive of his advantage, all these indicate very distinctly the intention of the Creator, and point to the development and the training of the human faculties, as one great end for which man was stationed in this lower world.

Nor is the relation in which man stands to his own species a less striking indication of the same truth. I have already noticed in this light the remarkable arrangement by which man is placed in families, and the child, by slow degrees, advances through the various stages of infancy, boyhood, and youth, to the full vigour and maturity of his faculties;* but all the relations of society speak a similar language. It is by the mutual intercourse, transactions, and arrangements of social life, its sympathies and emulations, its wants and desires, its very hatreds and contentions, that the human mind is strengthened, enlarged, and exalted, till its intellectual powers rise to so stupendous a height, and become able to survey so wide a field.

Now, the adaptations of man's physical and mental

* See "Spring,"—Papers on the effects of protracted childhood.

faculties to this peculiar state are very remarkable. Of his bodily powers I have already spoken, and, in the quotation from Cicero, the hand was particularly mentioned. This wonderful instrument, in conjunction with the arm, may be regarded as the perfection of mechanical power, consisting in a combination of strength, with variety and extent of motion, and with a nicety of touch, which conveys to the mind definite ideas of the figure, of the hardness, and of the consistency of bodies. Although the superiority of man is assuredly not owing, as Anaxagoras maintained, to the possession of a hand, yet without it he would be comparatively powerless. He would want the means of effecting what his ingenuity might suggest; and his ingenuity itself would be kept in abeyance by that very want. "This," says Mr Turner, "is the sceptre of his power, his instrument of domination, his all-conquering and all-transcending mechanism. It has all the potentiality of an enchanter's rod, and has achieved those wonders of human art, strength, and ingenuity, which the magicians of our imagination might toil in vain to surpass. We have not the eagle's talons or the lion's claws at the end of our fingers; but we can arm them with swords, guns, and bayonets, far more terrible. All that we admire and dread and use in mechanism and manufacture, in art, war, luxury, labour, and comfort, is the produce of the human hand."*

This admirable instrument, however, would be of little benefit without the informing and directing mind. It is still but an instrument; and one of the irrefragable evidences of Creative contrivance and adaptation is the gift of such an instrument to the only being possessed of a reasoning and intelligent soul. There is no other terrestrial animal on whom it would not have been bestowed in a great measure in vain.

It is not my intention to enter into any formal analysis of the intellectual powers; but it is impossible not to perceive that the correspondence between these and

* Sacred History of the World, vol. i. p. 509.

the structure of the human frame is exceedingly remarkable. Man has appetites, passions, and affections which incite him to act; he has ingenuity and judgment to enable him to contrive and to resolve; and, by the instrumentality of his bodily powers, he finds ability to execute. To these faculties and inclinations the external world is adapted. He has stone, wood, and iron at his command. With these materials he builds houses, constructs machinery, bridges rivers, traverses the sea in ships, and overleaps the barriers which set bounds to his habitation, and circumscribe his intercourse with his fellows. He does more. By the aid of an element, whose properties were unknown to early ages, he finds himself possessed of an agent of tremendous force; and his genius is again roused. He invents new and more complicated forms of mechanism, by which manufactures are improved and extended, commerce is promoted, and vessels are impelled through the ocean against wind and tide, while carriages career on land at a speed which emulates the velocity of the eagle, and seems almost destined to annihilate the obstructions of time and space, and to unite, as in one great city, the whole scattered inhabitants of the earth.

Meanwhile, the lower animals yield to the sway of man, subdued not by his physical force, for in this he is inferior to many, but by his mental skill. He destroys the noxious; he cherishes the useful and subservient; he extends his plastic hand over the earth, and, causing the desert to blossom as the rose, multiplies the numbers both of his own species and of the animals he has subdued to his service. Hence, again, proceed new inventions and new triumphs. The very elements bend to his control. The rigours of winter are softened; the breath of spring becomes more balmy; summer is decked in fresh charms; and autumn teems with additional plenty. Doubtless there are bounds to all these acquisitions; yet it is not man who shall prescribe them, but the fiat of the Deity himself.

TWELFTH WEEK—THURSDAY.

MAN.—HIS MORAL POWERS.

"In man," says Voltaire, "there is more wretchedness than in all the other animals put together. He loves life, yet he knows that he must die. If he enjoys a transient good, he suffers various evils, and is at last devoured by worms. This knowledge is his fatal prerogative; other animals have it not. He spends the transient moments of his existence in diffusing the miseries which he suffers, in cutting the throats of his fellow creatures for pay; in cheating and being cheated; in robbing and being robbed; in serving that he may command; and in repenting of all that he does. The bulk of mankind are nothing more than a crowd of wretches equally criminal and unfortunate; and the globe contains rather carcasses than men. I tremble at the review of this frightful picture, to find that it contains a complaint against Providence itself; and I wish I had never been born."

In this picture there is a certain horrid verisimilitude, though it is darkened and deformed by the bitterness of the misanthropist, and the impiety of the atheist. It is not with the moral powers of man as with his intellectual. He has lost the image of God which was originally stamped on his soul; and as regards his moral nature, is launched on the ocean of life, a ship at the mercy of every wind and current, without a rudder and without a pilot. He does not, therefore, improve in purity and virtue by the discipline of life as he does in mental capacity. On the contrary, his progress in morals seems to be retrograde as his intellectual faculties expand by exercise; and, by the intercourse of society, he becomes more regardless, more depraved, more impious. His love of evil increases along with his power of perpetrating it; and, if left to himself, he at last exhibits a

spectacle little different from that which the infidel Voltaire has portrayed with so ruthless a hand. The Apostle Paul describes the inhabitants of the heathen world, in his day, in terms scarcely less painful:—"As they did not like to retain God in their knowledge," says he, "God gave them over to a reprobate mind, to do those things which are not convenient; being filled with all unrighteousness, fornication, wickedness, covetousness, maliciousness; full of envy, murder, debate, deceit, malignity; whisperers, backbiters, haters of God, despiteful, proud, boasters, inventors of evil things, disobedient to parents, without understanding, covenant breakers, without natural affection, implacable, unmerciful: who, knowing the judgment of God, that they which commit such things are worthy of death, not only do the same, but have pleasure in them that do them."*

This is assuredly no rhetorical and misanthropic picture like that with which I commenced this paper, but a simple statement of the condition of heathen society in the days of the apostle. The arts and sciences had increased beyond all precedent in the empires of Greece and Rome, and moral depravity had kept pace with intellectual acquirements. To this melancholy fact history bears witness; and the description of the state of manners in Rome, by historians almost contemporary with Paul, corresponds but too truly with that which I have quoted.†

The truth and depth of observation with which some heathen philosophers speak of the depravity of the human heart, cannot be contemplated without wonder, as the profundity of their views seems to be such as was

* Romans i. 28, 29.

† See Sallustii Bell Catil. cap. 12, 13. The language of Sallust coincides very remarkably with that of the apostle. "Ex divitiis juventutem luxuria atque avaritia cum superbia invasere; rapere, consumere; sua parvi pendere, aliena cupere; pudorem, pudicitiam, divina atque humana promiscua, nihil pensi, atque moderati habere." "Sed lubido stupri ganeæ, ceterique cultus non minor incesserat:—viros pati muliebria, mulieris pudicitiam in propatulo habere: vescendi causa terra marique omnia exquirere," &c. &c.

scarcely attainable by the unilluminated intellect of man. Plato in particular speaks of original sin with an accuracy little short of an enlightened Christian. "The Divine nature," says he, "originally invigorated the human soul; but, when this was alloyed, humanity came to be reduced to the present standard, to the corruption and degradation of the human race; and from that fountain have flowed all the evils of mankind."*

This sentiment he repeats in various forms of expression in different passages of his works; and what is not less worthy of remark, he seems to have penetrated still deeper into this great mystery, and darkly, indeed, but not doubtfully, to have looked forward to the remedy which the Divine wisdom had provided. "God, the parent and author of this system," observes that remarkable genius, "beholding the world placed in this calamitous situation, and resolving that it should not be entirely destroyed by the disorder into which it was thrown, again seizes the helm, and carefully guides it, that he may unite its loosened, and as it were incongruous, materials; and restoring them to their original order, may finally adorn and improve them."†

There is something very striking in the discovery of these sentiments in a heathen philosopher; and if we are not to believe that in some unknown way they derive their origin from revealed truth, they at all events show the gigantic efforts of human reason struggling with a mysterious subject, which it in vain attempts fully to grasp.

Shall we then say, with the atheist, that "the frightful picture," which he draws, "contains a complaint against Providence?" God forbid! Let us examine this matter calmly, with the aid of that light which comes down from heaven. If we ask, why, under the government of a holy God, the moral powers of man are in a state of disorder, while his intellectual faculties are vigorous and active? this question, so full of mys-

* Plato in Critiâ, pp. 106 and 121. † Plato Politic. p. 251, in argument.

tery, can only be answered by God himself. And he has answered it. He tells us that he made man upright but free, and that by abusing this freedom he fell, and in his fall shook the world to its centre, blighted the face of nature, and changed the character and destiny of all living things. If, again, it be asked, why man was permitted to fall? or having fallen, why he was permitted to exist for a moment in a world which he had polluted, and under the sustaining hand of the Creator, against whom he had dared to rebel? here once more the mystery is solved by revelation, and a scheme of mercy and grace is unfolded, which displays the character of God in the most awful indeed, but, at the same time, in the most glorious and endearing light.

In this scheme not only are the power and wisdom of the Eternal presented to us in a new and astonishing point of view, but new attributes of the Divine nature appear, in contemplating which the soul is lost in wonder, love, and gratitude. The fallen race of Adam were permitted to live, that, under the moral government of the Son of God, and through the influences of his Spirit, the ruin of the fall might be repaired; that evil might become the parent of good; that folly, taught by experience, might be made the handmaid of wisdom; that sin, when chastised, might issue in holiness; and that the long train of disappointments and sufferings, diseases and deaths, might pave the way which should lead the humbled but penitent sinner to glory, honour, and immortality.

Strange but glorious plan! In sinful man is realized a scheme of divine government as far surpassing the previous conceptions of short-sighted humanity as east is distant from the west,—as heaven is higher than the earth. What human wisdom could have conceived a system of grace to sinners, founded on the long-suffering mercy of a just and holy God, in which *Satan* himself should be employed as a teacher of righteousness, in which the King of Terrors should be converted into a

messenger of joy, and in which God should be just while he is the justifier of the ungodly?

How awful! how mysterious! yet how full of beauty and of grace is the God of revelation! His way is in the sea, his path is in the great waters, and his footsteps are not known. But it is enough for us to be assured that he is the Lord God, merciful and gracious, long-suffering, and slow to anger; who takes no pleasure in the death of sinners, but rather that they should turn from their iniquities and live; who is in Christ Jesus, reconciling the world unto himself, and not imputing unto men their trespasses.

I say nothing at present of the unhappy state of those who go down to the grave without hope. They are in the hand of God; and it is not for mortal man to withdraw the veil in which this awful subject is involved. Doubtless the Judge of all the earth does right; but there are some things connected with the existence of evil which seem destined not to be revealed on this side of the grave. To our awakened sight the light poured on these mysteries, we may well believe, will form a theme for new admiration and praise throughout the ages of eternity.

Meanwhile, let us take comfort in the declarations of the revealed word. These promises are to us and to our children. This is not the history of God's dealings with another world, but with the world in which we live; it is not an account of grace and mercy to another guilty race, but to the very race to which we belong; nor is it to other individuals of that race only that these inestimable blessings are offered, but to ourselves. If we will accept of the offered salvation, we are included in that history—the objects of that grace and mercy—the partakers of these inestimable blessings. What manner of persons then ought we to be?

TWELFTH WEEK—FRIDAY.

MAN.—PHYSICAL EFFECTS OF CLIMATE.

THAT the whole human race is originally derived from a common parent, must be admitted by all who acknowledge the authority of Scripture, although there have been some daring speculators, who, not more contrary to the dictates of Revelation, than sound philosophy, have attempted to maintain an opposite opinion. Whence, then, the varieties of the human race, so remarkable, especially in three great branches, distinguished by their colour into the fair, the yellow, and the black; or, by their aboriginal habitation, into the Caucasian, the Mangolian, and the Ethiopian tribes?

This question cannot be answered satisfactorily in a few words. Nevertheless, there are some well known facts, the mere mention of which may serve to allay the surprise at first excited by the contemplation of these varieties, and may tend to show how consistent such variations are with the physical laws which pervade organized existence. The changes which are naturally effected by cultivation, in the appearance and qualities both of the plants and animals which have been subjected to the influence of man; the effect which a peculiar quality or conformation accidentally occurring in the parent produces in the offspring, frequently observable for many generations; and especially the influence of food and climate on the physical constitution,—seem of themselves quite sufficient to account for the remarkable varieties which the human frame exhibits in its different branches. It is to the latter effect that I intend at present to confine my attention.

One remarkable effect of climate is to darken the skin. That this results from the heat of the intense rays of the sun, may be fairly inferred, not only from the fact

that we find the inhabitants of the tropics, without exception, of a complexion more or less dark, but also from another, and perhaps a more convincing fact, that the descendants of Europeans, when transported to the equatorial regions, assume the black tint after the lapse of some generations. This is strikingly exemplified in the case of a colony of Jews, discovered in the Indian peninsula. Now, that this is a wise provision, we might safely conclude, from what we know of the provisions and accommodations of nature in other cases: But the philosophical principle can be assigned. It is true that a black colour, as I have elsewhere observed, absorbs the heat more readily than a white; and, therefore, if this were the only thing to be attended to, one would expect the complexion of the human body to be reversed in its locality, the purest white being found where the rays of the sun were most powerful, and the darkest in the regions verging towards the poles. But there is another principle which the progress of chemical science has very recently elicited, and which most satisfactorily accounts for the arrangement; it is this,—that a dark surface radiates heat much more readily than a surface of white. Now, the chief source of heat in a living body, is not the external atmosphere, or the rays of the sun, but the animal warmth, as it is called, that is, the heat generated inwardly by some hitherto obscure chemical process in the blood. It is of more importance to the comfort and health of the frame, that this internal source of temperature should be properly regulated, than that which is external; and this is the provision which the wisdom of the Creator has actually adopted. In the colder regions, the fairness of the skin prevents the escape of the animal warmth; and, in the warmer, a dark colour is superinduced, that the same warmth may freely escape, thus compensating, in some degree, by this remarkable contrivance, for the differences in climate. The same principle operates, indeed, to a certain extent, even in temperate climates, where exposure to the summer's sun is well

known to darken the complexion, an effect which the return of winter removes.

Another peculiarity induced by climate, is a difference in the freedom and extent of the perspiration, which serves also to modify the heat of the body. In the warmer climates, the pores are comparatively open, and the perspiration issuing freely, carries off from the frame the superabundant caloric, and at the same time bedews the body with a moisture which, in its evaporation, contributes not a little to create an agreeable coolness. But, besides this, there is a remarkable quality in the human body which enables it to resist the application of even high degrees of heat. This has been proved by various interesting recent experiments; and it is on this principle, that some individuals have astonished the public by the exhibition of their power of existing in an oven, or an apartment, heated to such a considerable extent, as to roast the flesh which has been placed by their side. A similar power exists in the living frame, as regards cold; and, in both instances, habit produces an extraordinary accommodation on individuals long resident in a particular climate, and still more in their progeny after the lapse of some generations.

In another particular, there is an adaptation to heat of climate, of which St Pierre, alluding to the Negro race who inhabit Africa, the hottest region of the globe, thus writes:—"Nature has covered the head of those careless and unindustrious tribes with a fleece more crisp than a tissue of wool, which effectually shelters it from the burning heat of the sun. They are so perfectly sensible of its accommodation to this purpose, that they never employ a substitute head-dress; and there is no description of mankind among whom artificial coverings, as bonnets, turbans, hats, &c. are more rare than among the Negroes. They use such as are foreign to them, merely as objects of vanity and luxury; and I do not know of any one that is peculiar to their nation. The inhabitants of the peninsula of India are as black as they;

but their turbans communicate to the hair, which, but for their head-dress, would perhaps be frizzled, the facility of growing and expanding."*

But the chief physical effect produced by heat of climate, is that of relaxing the human frame, and making it less capable of exertion; and it is very remarkable, as an instance of accommodation to circumstances, that, where this unbracing effect is produced, nature is most liberal in her distribution of esculent plants and fruits; as if it were intended, by this profusion, to compensate for the want of energy in the human constitution. Hence also a moral effect is combined with what is purely physical, the nature of which will fall to be mentioned in the following paper.

TWELFTH WEEK—SATURDAY.

MAN.—MORAL EFFECTS OF CLIMATE.

That some effects of a moral as well as of a physical nature are produced on the human family, by differences of climate, can scarcely be doubted, though these effects are probably less marked than has frequently been alleged. That sloth, effeminacy, and a tendency to the excessive indulgences of sense, are more remarkably characteristic of the voluptuous regions of the tropics, than of those of sterner aspect, which verge towards the poles, is very generally admitted; and that this difference arises from causes partly physical, and partly mental, can scarcely be called in question.

It is not to be doubted, that a hot temperature of the atmosphere tends to enervate the human body; and it is possible, too, that a similar state of the climate may have some effect in exciting the passions, so far as these are of a physical nature; but if this influence were as powerful as has been alleged, it would be much more uniform and

* Studies of Nature (Hunter's Translation), vol. ii. p. 4.

permanent than history proves it to be. The abject Greeks and Romans of the present day, how utterly unlike are they to their predecessors of the ancient world! Yet the climate of these classic regions, though there is reason to believe it has been in some respects altered by the progress of agricultural improvement in the adjoining continent, is not so different from its former state, as to make any important alteration in the physical state of the human body.

Moral effects, however, are not of so fixed and permanent a nature as physical; they depend on more numerous combinations, and circumstances of a more arbitrary nature; and it is to these chiefly that we are to look for the character produced in man by climate.

The effect of climate in raising an exuberant supply of the necessaries of life, has already been frequently alluded to. This of itself is calculated to create a very marked difference in the human character, and may, without having recourse to any other cause, account for much of the difference which subsists between the inhabitants of these regions, and those of climates where nature is less bountiful. Abundance gives rise to indolent and luxurious habits, while privation renders men hardy, intelligent and adventurous. But this is a moral effect, although it arises from a physical cause. We can now understand why a nation may, at one time, be vigorous, enterprising, and enlightened, and at another sunk in sloth and barbarism, although nurtured in the same climate, and subjected to the same influences of the seasons. The moral causes may be changed. There may be abundance where there was formerly want, and hence a stimulus to exertion may be removed; or an oppressive despotism may have so ground the faces of the people, that they have ceased to possess the moral aspect of free-born men, while they retain all the vigour of their bodily powers.

But there are other causes originating in climate, which operate no less certainly and effectually in pro-

ducing a moral influence on the minds of men. Among these may be mentioned the alternations of the seasons, which differ in their intensity in different countries, and thus produce a considerable effect in forming what has been called a national character. This may be illustrated by contrasting the character of the French nation, for example, with that of their neighbours in Britain. There is, doubtless, much in this difference of character which arises from the insular locality of the one, and the continental situation of the other. It is to the diversity of condition now alluded to, that we may fairly attribute the warlike propensities of the Gallic nation, and the commercial spirit of the British; and not less, perhaps, the free institutions of the latter, which have for centuries fostered the spirit of inquiry, of enlightened enterprise, and of improvement in all the departments of life. But in comparing the character of the French nation with that of our own country, there is one striking trait, which seems to depend, almost entirely, on difference of climate. I allude to the deficiency of the former in domestic habits. In Britain, our changeable climate, and the long evenings of autumn, winter, and spring, confine the inhabitants much to their homes. There they acquire habits of social intercourse, and of sober reflection. The ties of husband and wife, of parent and child, of brother and sister, are drawn closer as they surround the family fireside, and unbend their minds, or indulge their affections, or communicate mutual instruction. They study, they converse, they join in innocent amusements; and haply a higher theme occupies their attention, which raises their attachments above earthly things, and gives them the "rivet of eternity."

Habits thus formed become permanent, and are extended to all the transactions of life. The employments of summer partake of the qualities impressed on those of the other seasons of the year; and the pleasures of home, with which so many pure and elevating,—I had almost said holy,—principles are associated, and on which

so many valuable habits depend, have thus become part of the national character. The inhabitants build villas; they tastefully adorn their grounds; they cultivate their gardens; they surround their houses with comforts, with conveniences, with luxuries; and all these labours are only external indications of the deep-rooted love of home which has taken possession of their hearts. Hence the natives of our favoured island are, in comparison with those of the neighbouring country, affectionate, social, contemplative; and, may I not add, what is far higher praise, virtuous and charitable, enlightened and religious?

Our Scottish bard, speaking of the cultivation of the domestic virtues, in humble life, which he had so beautifully portrayed in his "Cottar's Saturday Night," says truly,

> "From scenes like these, old Scotia's grandeur springs,
> Which makes her loved at home, revered abroad;—

and happily it is not to humble life alone, nor to the people of Scotland, that these virtues are confined. They are every where intimately associated with the employments and relaxations of the middle classes, and shed respectability and value on the character of the highest ranks in the land.

In France, on the other hand, and more especially in her southern provinces, the weather is much more steady and equable during all the seasons of the year, affording free opportunity for exercise in the open air. In that delightful climate the inhabitants can very generally move abroad in every part of the day; and the evenings, when the family circle might meet together for the enjoyment of domestic charities, are comparatively short. There is little time, therefore, for the formation of that character which depends on the intercourse of the family circle; and the consequence is, that for domestic comfort they are even destitute of a word in their language. They know nothing of that simple neatness which adorns our cottage gardens and the dwellings of our farmers, nor

of those elegancies of domestic taste among the higher ranks which have given rise to what has emphatically been called English gardening. The houses of their peasantry, and the chateaus of their gentry, are equally devoid of that air of snugness, convenience, and accommodation, which forms so striking a feature in an English landscape. In truth they do not cultivate that domestic intercourse which constitutes so much of the happiness of life among us. It is not at home, but in the sports of the field, or in the bustle of society, or in the excitements of theatrical exhibitions, that they spend their hours of relaxation. It is there that they live and breathe and receive enjoyment. The effect of all this is strongly indicated in their character. They are ingenious but frivolous, sprightly but heartless; creatures of impulse and excitement, but void of depth and sincerity; or if they apply their minds to study, they are acute and inventive, discursive or philosophical, sometimes indeed excelling in the highest departments of intellect, but seldom sober-minded, moral, and pious. It is the fault of their education, originating in an abuse of that beautiful climate which was bestowed on them for a blessing, and may yet, in better times, be employed in a manner more conformable to the high ends of human existence.

Were we in like manner to examine the circumstances which, in other countries, give rise to national character or serve to modify it, we might probably find that the moral influence of climate forms almost everywhere one of its constituent elements. But enough has already been said to show the connexion which it has pleased the Creator to institute between mind and matter, even in things which, at first sight, may seem remote and uninfluential; and to afford us a glimpse into that complicated and admirable, but sometimes recondite machinery, by which the moral discipline of the world is conducted.

THIRTEENTH WEEK—SUNDAY.

CONFUSION OF TONGUES.

"God is not the author of confusion but of peace." So do the holy oracles affirm. Any one who has fixed his mind on the ordering of the seasons; the diurnal and nocturnal succession; the invisible but unvarying law, "which hath placed the sand for the bound of the sea, by a perpetual decree that it cannot pass it—and, though the waves thereof toss themselves, yet can they not prevail; though they roar, yet can they not pass over it,"—any such person must own that the God of *Nature* is the God of order. Again, who that has marked the regularity with which the fertile earth gives forth her returns to the husbandman; how the hand of the diligent maketh rich; how the habits of the temperate and abstemious procure sanity of the bodily and mental constitution,—but must own that the God of *Providence* smiles benignly on the observance of order in his creatures. Or, should we study the minute directions condescendingly given to the children of Abraham, when they had escaped from the misrule and severities of Egypt, and knew not how to arrange their journeyings in the wilderness; should we mark the rules by which they struck and carried the tents, and how each tribe had its locality fixed in the order of march; and how each had its camp and distinguishing standard attached to it, with the ensign of his father's house; and how the station of the Levites was round about the tabernacle of the testimony; and how their time to march, or to convene, either in whole congregations, or only in a council of the princes, was guided by the varied signals of two silver trumpets;—should we study these things, will not irrefragable proof be furnished, that the God of Revelation is the God of order?

On looking abroad through creation, however, we are arrested by many tokens of confusion: we see hills, which might have been covered with smiling flocks, broken into unproductive precipices;—streams, which might have irrigated many a meadow, foaming along in limited and rocky channels;—nations, which might have been united in one extended continent, cut up and dissevered by many a league of ocean;—limbs, formed with evident design to sustain frames which are rendered helpless without them, distorted and withered;—delicate organs, constituted to convey the delights of sound and vision, rendered tuneless and sightless;—and—O still deeper profundity of frustrated purpose and averted design!—affections, calculated to sweeten and alleviate,—souls capable of deep emotion and noble enjoyment,—perverted into the very gall and wormwood of the cup of life, degrading him who owns them, and dishonouring the God they are capable of glorifying.

The student of revelation, and the student of his own heart, will alike readily admit, that much of this confusion is not accidental—is not the result of mistake or misrule, but the necessary and irreversible result of man's moral departure from conformity to the image and will of the God of order;—a state of things bound fast in the laws of the Holy One, whose mind and will terminate in the most beautiful consistency and correctness: and, therefore, whose mind and will cannot be contravened, without producing a confusion from which all the perpetrators of that contravention must suffer, though it can in no wise touch or approach unto Him who inhabiteth the praises of eternity.

Amongst the confusions which are most prominent, and which to the learned, or to the expanded mind, are most incommodious, is the diversity of speech which the nations of our world experience. Let the native travel but to the summit of his mountain, or cross some rill which, in its insignificance, forms no barrier to intercourse, and he shall find the dwellers on the other

side as barbarians to him. Each possesses the curious and ingenious structure, which constitutes the complex organs of speech; each experiences the wants which would render communication a great convenience; each inherits the social temperament, which would spring forth into converse;—but, with all these appliances, they can hold no intercourse. Their tongues are diverse, and from that springs a sentiment of distrust and suspicion, often productive of enmity. Let the man of research seek to profit by the wisdom of other ages; open to him libraries rich in the lore of ancient philosophers,—he encounters a barrier which sends him back to his horn-book; and, instead of attaining the knowledge after which he pants, he must defer his thirst for a year, it may be, or a far more extended portion of his brief span, and resume his Lexicon, and Grammar, and school-boy habits. Let the Christian philanthropist overcome his love of ease, break the ties of home and country, sever himself from the communion of the Church, and traverse oceans to reach a land where he purposes to proclaim, that the kingdom of Heaven is come;—his zeal is restrained, his hopes are deferred, the object of his mission is forced into the back-ground, while his powers are all applied to the tedious process of acquiring an unknown tongue. When at last he would emerge from behind this formidable and discouraging obstacle, and tell of the Saviour on whom his own hopes are set, he does not proclaim with freedom and courage the acceptable year of the Lord. No; his message is delivered in the dubious lispings of childhood; peradventure his imperfect acquisition leads him to utter that which he meaneth not, and, almost certainly, he exposes himself to the ridicule of those whom he would gladly teach.

Truly had the people been one, and had they possessed all one language, "nothing would have been restrained from them that they had imagined to do." But fallen man was not worthy to have such a gift confided to him. He proved this by trying the impious project

of raising himself a name, whose foundation was laid in his pride, instead of exalting the name of his God and Redeemer, the foundation of whose kingdom is laid in man's humility. He forsook the true God, and set up self as his idol, and sought to raise a tower to heaven, which should be as a uniting altar, lest his quickly multiplying race should be scattered. O sublime and simple power of the God whom he had forsaken! No earthquake shook the foundation of their tower,—no tornado hurled it from its place,—no pestilence destroyed the haughty workmen,—but "He confounded their language, that they might not understand one another's speech." The zealous, the ambitious, the worldly-wise, were suddenly reduced to a state of helplessness, tending to the ridiculous. Their unity of purpose was lost; their orderly plan was brought to confusion, and they left off building the city;—therefore was the place called Babel, "because the Lord did there confound the language of all the earth, and from thence did the Lord scatter them abroad upon the face of all the earth." Thus was man's power of combination in mischief checked, but thus also was his power of good diminished.

Fourteen centuries rolled away, when again on the same spot did a proud monarch endeavour to counteract the consequences of that early judgment, by commanding all people, nations, and languages, to fall down and worship the golden image he had set up. And many were there of the temper of the men of Babel, ready to unite in a vain-glorious project. But in vain did all the people, the nations, and the languages fall down at the appointed and clamorous signal, that they might thus exalt, not the golden image, but him who set it up—in vain, because certain Jews, of the sons of the captives, regarded not the king and his graven god. The triumph of the lordling was incomplete so long as three men in his wide dominion dared to worship according to their conscience. How often has the cause of truth appeared

in this perverted world, in a minority as feeble, and how continually does the confusion which sin has wrought, exhibit itself in the transient elevation and injurious triumphing of the wicked. Even in Babylon, then, there were found three men of one country, willing to peril life for the glory of the living God,—three of the family of Israel, who had so far emerged from the obscurity of a state of bondage, as to be counted worthy of subjugation in this matter. They calmly replied to the threats of the despot, "If it be so, God whom we serve, is able to deliver us from the burning fiery furnace, and he will deliver us out of thine hand, O king. But if not, be it known unto thee, O king, that we will not serve thy gods, nor worship the golden image which thou hast set up. Then was Nebuchadnezzar full of fury, and the form of his visage was changed." Hast thou forgotten, O king, the tradition attached to thy city of old? hast thou no dread of Him who scattered thy predecessors, even the original builders of thy Babel? Wilt thou dare to lay hands on the worshippers of Him, who confounded their language of old? Even so, thou lordly one, for thou seest not by faith the Son of God, who is nigh to all that call on him, and is afflicted in all his people's afflictions. But "the angel of his presence saved them;" and the persecutor of the three whose meek courage had not forsaken them even in the fire, was made the first to invite them forth of his ingeniously constructed furnace, confessing them to be the servants of the Most High God.

Thus did three men who trusted in God, and changed the king's word, and yielded their bodies that they might not serve nor worship any God except their own, the Eternal and Unchangeable, rebuke the pride of their powerful conqueror, and frustrate his project of uniting once more in one evil object, those whose diversity of language had long estranged them from each other.

M. G. L. D.

THIRTEENTH WEEK—MONDAY.

HUMAN LANGUAGE.

One of the most remarkable and important of human acquirements is the use of articulate sounds, without which no very extensive intercourse could have been carried on between man and man, and the progressive improvement of society must have been extremely slow and limited. The lower animals, as has been already observed, have some kind of communications with each other, both by signs, and by the emission of sounds, which constitute a language suited to their nature; but they know nothing of articulate sounds, or what has been called conventional language. This acquirement was reserved for the human race, and forms one of man's remarkable and distinctive characteristics.

But man has a natural language as well as the inferior animals. He instinctively expresses his wants and his passions by signs and by inarticulate sounds. There is, in this respect, an universal language, which, like the language of the inferior creation, requires no instruction to understand. By the features of the face, and the gestures of the body, various emotions can be most significantly communicated. Joy and sorrow, indignation and pity, surprise, terror, and exultation, with every other powerful feeling of the mind, are thus represented. These signs and gestures are the instantaneous and involuntary effects of passion, and they speak a language which cannot be mistaken.

The instinctive modulations and tones of the human voice form another branch of natural language. These cries are uttered involuntarily even in infancy, and at every period of life they burst forth spontaneously, in spite of all artificial refinements, without design, and even contrary to inclination. They form the nearest approach to articulate sounds; and some of them are

even introduced into written language, under the grammatical name of interjections; but yet the difference is marked and specific. The intonations accompanying these sounds, are not, however, confined to them. They are carried into all the utterances of artificial language, and form, in common conversation, as well as in oratory, one of its most interesting and impressive features.

It is obvious that these natural signs might have been sufficient for carrying on a limited intercourse in the rude stages of society; but they could never, even although greatly extended, have answered the purposes of civilized life; and, indeed, society could not have advanced a step beyond these rude stages, without a far more perfect power of communication. For purposes of improvement, man requires not merely to communicate to his fellows his feelings and passions, but ideas of objects, of actions, of relations, of abstract thoughts, of trains of reasoning; and something much more precise and varied than signs was therefore necessary. This essential gift has been bestowed in the power of forming artificial or conventional language.

I have already noticed those properties of the atmosphere which render it a fit vehicle of articulate sounds, as well as the adaptation of the ear for the reception of such sounds, and their conveyance to the mind. I have now to mention an equally remarkable adaptation, in the organs of speech. The windpipe, the tongue, the teeth, the lips, are all admirably formed, among their other important uses, for this express purpose. Were any one of them made otherwise, some part of that admirable mechanism would be imperfect, which, as at present constituted, forms an instrument of such wonderful power and beauty. We are so accustomed to the human voice, that we are apt to overlook its perfections; and it requires some effort to induce us to attend to the means by which we obtain so familiar, but so delightful and necessary an endowment. But were we to enter into an analysis of the organs of speech, we should find.

at every turn, proofs of the most refined and careful contrivance, for rendering the instrument such as might be best employed in conveying the sentiments of a rational creature, equally as regards precision, harmony, and emphasis. It is enough, however, for our present purpose to know, that these effects are actually produced by a complicated combination of mechanical powers, which it has baffled all the resources of human art to imitate.

In the origin of language there seems to exist some obscurity. Much ingenuity has been expended in endeavouring to show that it was entirely the fruit of human invention. But the difficulties with which this supposition is attended are confessedly great; and its most zealous advocates are forced to admit, that language could only have originated in the surpassing genius of some superior minds. The opinion most consistent with probability is, that the Author of our nature, who bestowed the requisite powers and faculties, also taught the mode of exercising them.

There are two facts which strongly bear on this point; the one is, that wherever, from defects in the organs of hearing, or from seclusion in infancy from human society, no opportunity has been afforded of learning articulate sounds by imitation, the faculty of speech has always been found wanting, except so far as subsequently acquired with labour and perseverance, by instruction from those who have previously practised it; and the other, that in all cases, the actual power of articulation is found to be so much limited to the formation of those sounds only which have been acquired in infancy, that it is with great difficulty the pronunciation of any new sounds can be attained at a more advanced age. But, independent of this, the succinct narrative which is afforded us in the inspired volume of the state of man in Paradise, seems greatly to favour, if it does not expressly declare, the immediate interference of Heaven to communicate this important instruction; for we are told,

that God caused every beast of the field and every fowl of the air to pass in review before Adam, that, by observing their qualities, he might affix to them corresponding names; "and whatsoever Adam called every living creature, that was the name thereof." Man was then possessed, even at that earliest period, of the faculty of speech; and its copiousness and precision must have been quickly increased by the salutary exercise which was thus afforded, at once to his mental faculties, and to the power of giving them expression.

Language thus commenced, as philosophy, unaided by revelation, might have conjectured, by giving names to existing objects. The art once learnt, would be easily extended. From noting and expressing in words those things which come under the immediate cognizance of the senses, the mind would proceed to the formation of articulate sounds for conveying the idea of motions and qualities; and thence, again, it would rise to the marking of more abstract notions. A desire would be excited of expressing inward emotions and opinions more definitely than could be done by signs or exclamations. As soon as man received a companion of his own species, —that last and best gift of Creative Goodness,—the sympathies thus excited would originate this desire, and he would not be slow to follow its dictates. In the interchange of feelings and views, he would discover a gratification which would enhance tenfold the joys of Paradise, by reflecting them from a kindred bosom; and in this, more perhaps than in any other particular, he would find that it was good for him not to be alone.

Ingenious men have delighted to trace language in its course of development, as the wants, the feelings, and the opinions of men required to be communicated. In such an inquiry, there are few facts on which to rest a train of reasoning, and conjecture has been largely employed to supply their place. It is, however, obvious enough, that the copiousness of language would keep pace with the progress of knowledge, and the expansion

of the human mind; and, accordingly, it has, generally speaking, been found, that the fulness, if not the perfection, of a language, is a just criterion of the extent to which mental improvement has been carried among those nations which employ it. But this is a subject on which it is unnecessary to dwell. The possession of the power of speech is a boon for which we cannot be sufficiently thankful. That it is adequate to the expression of all the ideas necessary to be communicated in the ordinary intercourse of society, and capable of expansion in proportion as the range of the human mind extends, are properties which constitute its peculiar value.

Nor must we forget that language has a reflex influence on the mind, in giving a precision to our ideas and reasonings, which they would not otherwise possess; and that it is further of essential value, from the nature of its construction, which has enabled human ingenuity to separate its sounds into their constituent parts, and thus to originate the most beautiful and important of all human inventions,—that of the letters of the alphabet. Hence the origin and transmission of history, of literature, of the arts and sciences; hence the accumulation of human knowledge, and the indefinite improvement of the human species, rendered more rapid and more secure by the modern invention of the art of printing. The stimulus already given to the mental powers, and the effects produced by that stimulus, we can partly compute; but who can anticipate the changes which these acquisitions are yet destined to produce? It is a tremendous power which is thus put into the hands of mortals. Let us rejoice that it is under the control of a Being infinitely wiser and better than the race of Adam; and that, along with the works of fallible man, is transmitted an Inspired Volume, which has the Creator and Redeemer for its theme, truth without any mixture of error for its matter, and life and immortality for its object.

THIRTEENTH WEEK—TUESDAY.

HAY-MAKING.—PLEASURES OF RURAL SCENERY.

I BELIEVE few people have beheld the occupations of the hay field, which this beautiful season every where presents, without feeling a very pure and elevated delight. The mowers moving gracefully in concert, the grass falling sheer beneath the scythe, its grateful fragrance, the maidens raking or tedding the hay, the loading of the carts to remove it to the barn-yard, all excite a sensible pleasure in almost every mind.

"Wide flies the tedded grain. All in a row,
Advancing broad, or wheeling round the field,
They spread the breathing harvest to the sun,
That throws refreshful round a rural smell;
Or, as they rake the green appearing ground,
And drive the dusky wave along the mead,
The russet hay-cock rises thick behind,
In order gay; while, heard from dale to dale,
Waking the breeze, resounds the blended voice
Of happy labour, love, and social glee."

THOMSON.

Whence arises the enjoyment which this rural occupation calls forth, both in the bystander, and those who are engaged in it? It seems almost entirely the result of association. Something, indeed, may be attributed to the mere animal pleasure of a healthy employment in the open air, while breezes, freighted with sweet odours, breathe softly, and shed their salubrious influence around; but if we consider the matter calmly and discriminatingly, we shall find that by far the deepest and most exhilarating sense of the emotion, lies in suggestions and feelings chiefly of a moral and benevolent kind. How far there may be a pleasure of taste arising from the swinging motion of the mowers, moving as if actuated

by one common impulse, independent of any other principle of the mind, I shall not pretend to determine. Mental operations are so recondite, and the seat and moving cause of inward emotion is so mysterious, that, when we attempt to analyze, we may, in our ignorance, overlook some important element; but undoubtedly a chief part of our enjoyment arises from a secret sentiment of sympathy. A concerted movement implies a common will; and this, of itself, excites an agreeable sensation in the mind, when that will is directed to some useful object. The pleasure, too, arising from a scheme of utility successfully completed, is another moral element that enters into the feeling. The farmer has sown in hope, he is now reaping in joy, and we feel a sentiment of congratulation, even where we have no opportunity of expressing it. We place ourselves in his situation, and shadow forth to our imaginations what he must feel at this consummation of his labours and anxieties. That this is a very principal part of our enjoyment, will appear obvious, if we only consider, that the feeling is much enhanced by the luxuriance of the crop, and the favourable nature of the weather. Let any man fancy to himself, what would be his sensations, were he to see the very same operation going forward in a field overgrown with weeds, or where the hay was stinted in its growth, or withered by the drought; or if he saw the mowers plying their task, for some cause or other, in the midst of a storm: yet the movements are the same; the associations only are changed.

The very same observations may be applied to the other labours of the hay field. It is the pleasure of sympathy, an excitement of the benevolent feeling in our breast; and it is a wise arrangement of our Creator, that all rural occupations, prosperously carried on, are attended with a similar feeling. It not only increases the sum of our enjoyments, but, in a very salutary manner, exercises the social virtues.

Mr Alison, in his work on the "Principles of Taste,"

extends this view even to rural scenery. "A common English landscape," says he, "green meadows, with cattle, canals, or navigable rivers; well fenced, well cultivated fields, neat, clean, scattered cottages; humble, antique churches, with church-yard elms, and crossing hedge-rows, all seen under bright skies, and in good weather;—there is much beauty, as every one will allow, in such a scene. But in what does the beauty consist? Not certainly in the mere mixture of colours and forms; for colours more pleasing, and lines more graceful (according to any theory of grace that may be preferred), might be spread upon a board or a painter's pallet, without engaging the eye to a second glance, or raising the least emotion in the mind; but, in the picture of human happiness that is presented to our imaginations and affections, in the visible and unequivocal signs of comfort, and cheerful and peaceful enjoyment, and of that secure and successful industry which insures its continuance, and of the piety with which it is exalted, and the simplicity by which it is contrasted with the guilt and the fever of a city life; in the images of health, and temperance, and plenty which it exhibits to every eye, and the glimpses which it affords to warmer imaginations, of those primitive or fabulous times, when man was uncorrupted by luxury and ambition, and of those humble retreats in which we still delight to imagine that love and philosophy may find an unpolluted asylum."

There is much good feeling as well as sound philosophy in this view, although there may perhaps be a somewhat undue but excusable leaning to the author's own peculiar theory. The beauty and general truth of the sentiment that follows, cannot fail to strike every mind, whether the philosophical view which it is intended to establish be adopted or not. "At all events, however, it is human feeling that excites our sympathy, and forms the object of our emotions. It is man that we see in the beauties of the earth which he inhabits;

or, if a more sensitive and extensive sympathy connect us with the lower families of animated nature, and make us rejoice with the lambs that bleat on the uplands, or the cattle that ruminate in the valley, or even with the living plants that drink the bright sun and the balmy air, it is still the idea of enjoyment,—of feelings that animate the existence of sentient beings, that calls forth all our emotions, and is the parent of all that beauty with which we invest the objects of the inanimate creation around us."

Without determining whether or not there may be too much exclusiveness in this view of the origin of a sense of the beautiful, I shall add that there is here a foundation for a deep and enlightened devotional sentiment. While our sympathies go forth towards our fellow mortals, in the contemplation of the objects with which we are surrounded, we have but to take another step to connect this feeling with the Author of all that interests our affections, and calls forth our emotions. Such, indeed, is the habitual feeling of the pious mind. He sees God in every thing; and, whenever his heart overflows with pleasure, it rises in gratitude and admiration to the Source of all pleasure,—his taste acquiring new expansion, his sentiments additional force and elevation, and his enjoyments a warmer and brighter glow.

THIRTEENTH WEEK—WEDNESDAY.

THE VARIETY, BEAUTY, AND UTILITY OF ORGANIZED EXISTENCES.

The variety which characterizes nature is very striking, and never appears so remarkable as during the full flush of summer, when organized life is in its greatest vigour. The beautiful undulations on the surface of the earth, which exhibit every where new scenery, and delight us with their graceful outline and contrasted

figure and shades, form a fitting ground work for the varied productions which that surface contains. If we turn our eye to the vegetable kingdom, how numerous and how varied in form and qualities are the plants with which we are surrounded, and what diversities in their colours, their size, and their odours! From the humble moss to the stately oak there is a continual change of properties and of shapes, which seems to indicate variety as one of the prime intentions of the Creator; and yet, along with this variety, there is a constant reference to a general type. Although in every order and class there are specific differences, and in the various species of each class these differences are prodigiously multiplied, yet among them all there is a peculiar character which marks vegetable nature, and from that character there are no deviations.

The very same thing may be said of animal life. There are not fewer varieties in this department than in the former; and here, too, there is a particular type from which nature does not deviate. There may, in truth, be said to be only two types among organized beings, the vegetable and the animal; and even these have their analogies and correspondences which invest them with a similar character, and mark them with the impress of the same Almighty hand. But, within the limits which the Creator has assigned to himself, the variety is indeed amazing. It seems as if all forms, all properties, and all modes of existence were exhausted. Not only is there an immense diversity in the orders and families, but that diversity extends to individuals, so that it has been said, with great probability, that in the myriads of leaves belonging to the same tree, or to all the trees of the forest, it is impossible to find two in all particulars alike.

There is much wisdom and goodness in this sameness, combined with diversity. It is in fact the foundation of our knowledge of natural objects. Were there no plan in nature, there could be no generalization; were there

no diversity, there could be no individual distinctions. It cannot be said that this arrangement was necessary. It is easy to conceive a world formed altogether on a different scheme, or even without any scheme at all. That there is a distinct and harmonious system, implies intelligence; that it is diversified, implies some specific intention. What that intention is may be inferred from other considerations.

There is beauty in this diversity. That is to say, the human mind is so constituted as to derive enjoyment from the particular forms and combinations which nature exhibits. It may be difficult to determine in what the idea of beauty consists. This is a subject which has occupied the ingenuity of speculative minds, and given rise to different theories of taste; but on whatever principles of our nature it depends, the fact is the same. There is nothing in the general aspect or circumstances of the objects with which we are surrounded to excite disagreeable sensations. Sometimes, indeed, the eye may be shocked, or the ear grated, or the sense of touch, of smell, or of taste offended; but these are rare exceptions, just sufficient to show us how miserable we might have been rendered had nature been constituted otherwise. The adaptation of our perception of beauty to actual appearances is therefore a most beneficent provision.

The nature and extent of this adaptation are under no circumstances more observable than during the revolution of the summer months. What loveliness is abroad in the earth, the sea, and the sky! The morning-dawn bursting from the womb of darkness, the full splendour of noon, the softened charms of sunset and the evening twilight, and the glories of night which lights its thousand lamps,—what are these but so many indications of Divine beneficence? The balmy softness of the air, the ever-changing curtain of the floating clouds gracefully drawn over the sky to mitigate the excessive fervour, with the refreshing coolness of the

shade and the gentle breeze, speak the same language. The flowers that enamel the meadows, graceful in their form, lovely in their harmonizing hues, and grateful in the sweetness of their perfume; the herbage in its various kinds; the bushy shrubs; the majestic trees, differing in size, in shape, and in shade; the living world in all its diversities—the trout leaping from the pool, the busy insect fluttering in the sunbeam or moving across our path, the bird with its painted wing and sweet song, the domestic herds and flocks quietly grazing on hill or dale, the beasts of the forest which occasionally start from bush or brake,—each and all seem formed to fill the mind with agreeable sensations, and to raise it in adoration to the Giver of all good.

"Everywhere," says the pious Sturm, "nature works to procure us new enjoyments—even the smallest insects, leaves, and grains of sand offer subjects of admiration. The same brook that waters the valleys, murmurs sweet music to our ear, invites us to soft repose, and refreshes the parched tongue. The grove, which shields us from the piercing rays of the sun by its protecting shade, makes us experience a delicious coolness. The trees, whose beautiful blossoms so lately delighted us, will soon produce the most agreeable fruits; and the fields, waving with the ripening corn, promise an abundant harvest. Nature presents us with no objects pleasing and useful only in one respect. She clothes and adorns the earth with green, a colour most beneficial and agreeable to the eye, and adds to its beauty by diversifying its shades; for, though pleasing in itself, its charms are much increased by this happy distribution of shade. Each species of plant has its peculiar colour; landscapes covered with wood, bushes, plants, herbs, and corn, present a most beautiful scene of verdure, where the colouring is infinitely varied, and its shades insensibly blended, increasing from the lightest tints to the darkest hue, and yet a perfect harmony is always preserved."

But what is chiefly to be observed and admired in the diversities of nature is the adaptation of everything to some particular use, and of all to the completeness of the whole system. There is nothing isolated, nothing useless. The two divisions of organized existence are formed for each other. Every plant has some corresponding tribe or tribes of animals which it supports, and to whose properties and modes of existence it is peculiarly adapted; if there are succulent leaves, there are caterpillars to feed on them; if there are flowers which secrete honey, there are bees and other insects to sip the sweets; if there are fruits, there are birds to feast upon them; if there is herbage, there are cattle to crop it; and if there is death, there are living beings which convert even this to the support of life by devouring the inanimate carcass.

There is here a complicated and most wonderful system; and this system is so nicely balanced, as I have elsewhere shown, that every part is preserved in its due proportion, and one species contributes to the benefit of all. It is, however, to man especially that this system bears reference. We have seen, in the course of our inquiry, how wonderfully every thing is suited to his use, and with what ease he is enabled to control and modify Nature in all its varieties, so as to accommodate it to his necessities, and cause it to contribute to his comfort and prosperity. This is not the result of his own ingenuity, but of a scheme of infinite wisdom and beneficence planned for his benefit, and destined for the development of his faculties, and the discipline of his moral powers.

THIRTEENTH WEEK—THURSDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—ADAPTATION.

The great object of the present volume has been to consider the attributes of the Creator, as these are dis-

played in the full development of the qualities, powers, and faculties of natural objects, whether animate or inanimate. We have seen that these are all united together in a system marked with some very peculiar characteristics, the leading features of which, so far as these relate to organized beings, are growth, maturity, decay, death, and reproduction. To these conditions, whatever be their ultimate object, we find the whole scheme of sublunary things to be adapted. Their necessary concomitants are change, privation, infirmity, and pain. Without, at present, recurring to the religious view of the question, which amply vindicates this system by communicating to us those ultimate ends which revelation alone could unfold, let us look back on the ground we have traversed, that we may concentrate our argument, and see in what manner, under the restrictions we have mentioned, the power, wisdom, and goodness of the Creator have been established.

In the commencement of the "Winter" volume, I laid down two great principles as the objects of inquiry, namely, *contrivance* to avoid evils or to obtain advantages; and *compensation* for evils actually permitted or appointed. In the course of these volumes that inquiry has been prosecuted at length, and it may surely now be maintained that a system of such contrivance and compensation has been established by a superabundance of proof, and that thus the existence of a Being of pre-eminent wisdom and benevolence has been irrefragably demonstrated.

There is a view of the Divine operations as displayed in creation, partly differing from both of these, yet in some measure including them both, which has also been pointed out, and, I trust, distinctly proved;—I mean that which exhibits the scheme of the Creator, as a system of *adaptation to certain conditions*;—the contrivances and compensations being all so adjusted as to form a consistent whole, in which the various parts bear relation to each other, and conspire and harmonize in pro-

moting one important end. We have an example of this in the sun,—the source of light and heat,—and in the various elements of which the atmosphere and the soil are composed, which all unite their powers and qualities in nourishing vegetable and animal life; or, taking the converse view, we find this principle exemplified in the beautiful and skilful adjustment of the properties of vegetable and animal life, to the influence of the soil, the sun, and the elements. The same thing may be said of the relation which subsists between the vegetable and animal worlds themselves, and between the various species which exist in both of these departments. It is a relation of adaptation. Plants are made for living beings, and living beings for plants. Between them, and among each other, there is the most marked and admirable adjustment, always bearing reference to the five pervading conditions already mentioned, of growth, maturity, decay, death, and reproduction.

As our mundane system, therefore, is all relative, the most striking way, perhaps, of exhibiting its perfection, is to make a supposition of some alteration taking place in any one of its relations. We shall uniformly find that a derangement in the system would immediately take place; that, what in itself might appear to be an improvement would, in reference to the whole scheme, prove to be the very reverse; and that, in order to accommodate other properties or existences to that one change, the most extensive changes would be necessary, branching out into interminable relations, till the mind was lost in the pursuit of consequences.

There are some striking examples of the incongruity of such imagined alterations in St Pierre's Studies of Nature, and instead of seeking for them myself,—which were easy, for they are to be found every where,—I prefer making use of the speculations of that delightful, though sometimes imaginative writer. "For example," says he, "complaints are made of death; but if men were not to die, what would become of their posterity?

Long before now there would not have been room for them on the face of the earth. Death, therefore, is a benefit.—Men complain of the necessity of labouring; but unless they laboured, how could they pass their time? The reputedly happy of the age, those who have nothing to do, are at a loss how to employ it. Labour, therefore, is a benefit.—Men envy the beasts the instincts which guide them; but if, from their birth, they knew, like them, all that they are ever to know, what should they do in the world? They would saunter through it without interest, and without curiosity.

"The other ills of Nature are equally necessary. Pain of body and vexation of spirit, which so frequently cross the path of life, are barriers erected by the hand of Nature, to prevent our deviating from her laws. But for pain, bodies would be broken to pieces by every shock; but for distress, so frequently the companion of our enjoyments, the mind would become the victim of every sickly appetite. Diseases are the efforts of temperament, to purge off some noxious humour. Nature employs disease, not to destroy the body, but to preserve it. In every case, it is the consequence of some violation of her laws, physical or moral. The remedy is frequently obtained by leaving her to act in her own way. The regimen of aliments restores the health of our body, and mental regimen tranquillity of mind. Whatever be the opinions which disturb our repose in society, they almost always vanish into air in solitude. Sleep simply, and of itself, dispels our chagrin more gently and more infallibly than a book of morals. If our distresses are immoveable, and such as break our rest, they may be mitigated by having recourse to God. Here is the central point, to which all the paths of human life converge. Prosperity, at all seasons, invites us to his presence, but adversity leaves us no choice. It is the means which God employs to force us to take refuge in himself alone. But for this voice, which addresses itself to every one of us, we should soon forget Him, especially in the

tumult of great cities, where so many fleeting interests clash with those which are eternal, and where so many *second* causes swallow up all attention to the FIRST."*

THIRTEENTH WEEK—FRIDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—FUTURE EXISTENCE.

IN the previous paper it has been shown, that the system of creation is perfect in its relations, insomuch, that were any of its circumstances to be altered, far greater inconveniences than actually exist would necessarily ensue; or, in other words, that, taking the general scheme as we find it, the evils which result from it are at the *minimum*, and the advantages at the *maximum*. But still the question recurs, is the system itself wise and beneficent? In this inquiry there is much more difficulty than in the other; and, in order to answer it, we must have clear views of the ultimate object and intentions of the Creator. It is an inquiry which the natural philosopher has often blinked, and on which he has never successfully entered without the aid of Revelation. There are, however, some views apparently forced on the inquiring mind by nature itself, which seem to open a glimpse of the truth.

The first thing that naturally occurs to a philosopher examining this sublunary system by the light of nature alone, is, that there is a certain want of adaptation between the human mind and the world in which it exists; that, while every thing else is most strictly and wisely adapted to its situation and circumstances, man, the chief of earthly existences, is a remarkable exception. This is, to a certain extent, true of our natural wants:— "There exists not a single animal," St Pierre justly remarks, "but what is lodged, clothed, fed by the hand of

* Study viii.

Nature, without care, and almost without labour. Man alone, from his birth upward, is overwhelmed with calamity. First, he is born naked, and possessed of so little instinct, that if the mother who bare him were not to rear him for several years, he would perish of hunger, of heat, or of cold. He knows nothing but from the experience of his parents. They are under the necessity of finding him a place where to lodge, of weaving garments for him, of providing his food for eight or ten years. Whatever encomiums may have been passed on certain countries for their fertility, and the mildness of their climate, I know of no one in which subsistence of the simplest kind does not cost man both solicitude and labour."*

There are, doubtless, compensations for all these inconveniences, but they are such as prove incontestably that man is in a state of discipline,—that there is a studied plan to develope and exercise the powers and faculties of his mind. And for what? If this plan refer merely to a present life, so far as happiness and moral worth are concerned, it fails of its object. "When man has collected around him," observes the same author, "every thing necessary to a quiet and comfortable life, ambition, jealousy, avarice, gluttony, incontinency, or languor, takes possession of his heart. He perishes almost always the victim of his own passions." This is but too true of those who have no higher object than the gratification of their senses. Meanwhile, indeed, their intellectual faculties are cultivated and expanded; but to what purpose, if they are to go down to the grave and be "as if they had never been?"

If there be a future state of existence, the difficulty is solved; for in that case new and nobler motives of action are presented to the mind,—a regulating principle is introduced, which, like a skilful pilot, steers the bark to its destined port. We are no longer left to the mercy of the winds and waves, soon to perish miserably; but

* Study viii.

with our charts in our hands, we ply steadily forwards in spite of opposing storms and currents; courting every favouring breeze; assiduously avoiding adverse gales and currents, or even skilfully employing these to aid us in our course; and only at ease when we find ourselves making progress towards the consummation of all our anxieties and toils. The doctrine of future existence, then, is necessary to render our situation in this world intelligible; and the hope which it inspires, is of essential importance for the useful regulation of our lives.

It is from the nature of the human mind itself, however, rather than from external circumstances, that we derive the strongest argument of unassisted reason for the doctrine of immortality. Its powers and faculties are superior to its present condition. The objects with which it is conversant are not capable of affording it solid and permanent satisfaction. It is susceptible of indefinite improvement; but there is no sublunary pursuit sufficiently enlarged to occupy it, or sufficiently valuable to constitute its happiness. It is always aspiring, and never content. As its powers expand, they only become more unsuitable to its circumstances; and the more pleasures it is capable of enjoying, and the greater the range of knowledge it is able to grasp, the more deeply does it feel how inadequate are the things of earth to its gratification. This want of adaptation is totally unlike what takes place in other things. It is an anomaly of which Nature herself teaches us to inquire the cause.—We find it only in a future existence.

There is yet another consideration, arising from this view of the indefinite improvement of the human soul. It seems altogether inconsistent with the uniform analogy of nature that such a being should perish. Other animals possess just such faculties and instincts as fit them for the situation in which they are placed, and no more. As there is nothing wanting to them, so there is nothing superfluous. But it is otherwise with man if his soul is to be dissolved along with his body. Its qua-

lities, capable of unlimited expansion, shall then have been created in vain. They have only begun to exist; shall they be nipped in the bud? An interminable career is before them; shall they be arrested when the race is but just commenced? There is an intellect to cultivate, a moral faculty to exercise, duties to perform, and aspirations and hopes to cherish; have all these qualities and views been implanted to be suddenly quenched in nothingness? If so, then the analogy of nature is broken, and the noblest of the Creator's mundane works is an abortion.

These are the most powerful arguments by which, on the principles of reason, the immortality of the human soul has been maintained. He who has attended to the bearing of the facts which have been adduced in the course of our inquiry, will be best able to appreciate their force. If he is satisfied that in all other particulars the adaptations are complete, and that here only they fail, he will probably see reason to conclude, that this remarkable anomaly must be owing to the connexion of the human race with another system; and while in this he discovers an argument to prove the solid foundation of those future expectations which rise unbidden in his heart, and seem to be an instinct of his nature, he will at the same time perceive a new light cast on the whole system of creation. Man is in a state of preparation for a higher destiny. The world is formed to prepare him for that destiny. He is in the school of Providence, educating for immortality. The situation and circumstances of inferior existences, while they are suitable to their condition, are peculiarly, and above all, contrived for this object, and, with reference to him, are the means to that end. And here, again, there is the most consummate skill, the most comprehensive benevolence, the most refined adaptation!

These are, at least, plausible conjectures, but they are not demonstration. Let us rejoice that they are con-

firmed and rendered as certain as the existence of the Eternal himself, by Him who has "brought life and immortality to light by his gospel."

THIRTEENTH WEEK—SATURDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—DISCIPLINE.

When we become assured of the fact, that man is destined for immortality, all the difficulties which a view of Nature, as a state of change and decay, presented to the mind, are removed or diminished, and we come to see more clearly how the disorders which seem to prevail in the world, may be reconciled to the Divine perfections.

I have already adverted to this subject, and placed it in various aspects. At present, my object is to bring the question of discipline into one point of view, and to show its bearing on the condition and operations of external nature. Fatal experience proves that the human mind, as regards its moral faculties, is in such a state of disorder, that the ordinary events of life do not affect it in a salutary manner. Under the influence both of prosperity and adversity, as well as under alternate vicissitudes in our condition, the heart may remain unimproved. It may indeed be hardened and deteriorated by every change of fortune, and by every permanent state in which the events of life may place it. When surrounded with all the means of gratification, it may become selfish and worldly; when in circumstances of privation and suffering, it may be rendered peevish, disheartened, and discontented; when visited with alternate sunshine and gloom, selfish cares and anxieties may only gather the thicker around it.

It is not, then, in the mere circumstances of life, that we are to look for the moral improvement of the human character. It is true, as has already been shown, that

every thing seems naturally designed, and admirably contrived, for urging forward the intellectual improvement of man, and, in this respect, the system of discipline may be considered complete; but it is not so, as regards his morals. Here peculiarly lies the taint of the fall; and, what is asleep must be awakened,—what is dead must be revived,—the Divine image, which erewhile animated the soul, must be restored,—before apostate man can be in a fit condition to profit by the moral discipline provided for him.

The means of this renovation, however, are placed within his reach, and the disciple of Him who died for sinners, is freely invited to ask, that he may receive. The way is open, and cannot be mistaken; for it is traced by the blood of his Redeemer. To such a man, the world is a state of moral discipline, every way suitable to his condition. God is his Father, whose eye watches over him; whose hand supplies his necessary food; whose Book instructs him; whose smile cheers and encourages, whose frown awes, whose rod corrects him.

In this view, nothing can be more admirable than the adaptations of external nature to his situation. He is a child of a family early trained under the tender eye of a mother; and supported, during the helpless years of infancy, by the means provided for him by an affectionate father; and, in his brothers and sisters, associated with companions and equals who are bound together by a common lot. He thus early learns to bend to the yoke of authority; to be dependant and humble; to be docile, dutiful, and affectionate. His filial reverence, his fraternal love, his sense of duty, are thus called forth and cultivated; and all this domestic training prepares him for cherishing the still nobler principles of religious obedience and submission, and the more exalted sentiments of pious gratitude, veneration, and confidence.

In a more extended intercourse with his fellows, the Christian finds new opportunities of cultivating his vir-

tues and graces. When he comes into collision with the bad passions and evil practices of those with whom he is conversant, he sees, as in a mirror, his own heart reflected, and he learns to be diffident, watchful, and charitable. When he meets with men of congenial minds, who serve the same Divine Master, and are animated with the same blessed hopes, his heart glows with a kindred flame, and mutual sympathy forms his solace and his strength. When the world prospers with him, he blesses the Giver of all good, and, remembering that he must give an account of his stewardship, exercises himself "to have a conscience void of offence towards God and towards men." When affliction comes, he receives it as the chastisement of a Father, who chastens him for his profit: when death snatches a friend or partner from his bosom, he feels indeed that the lesson is severe, but he hesitates not to learn it, and in the resignation of his heart he exclaims, "The Lord giveth and the Lord taketh away, blessed be the name of the Lord."

If, in this spirit, a man engage in the various duties, and exercise the numerous relations of life, he finds that all the tendencies of his intercourse both with the animate and inanimate world, lie in the same direction. All are full of instruction, and wisely adapted to train him for immortality. He

> "Finds tongues in trees, books in the running brooks,
> Sermons in stones, and good in every thing."

It is true, indeed, that this effect is only partial. It proceeds but a certain length, and then stops short. While it presents heaven to our view, it still keeps us lingering among the things of earth; while it cherishes celestial graces, and fills the mind with high anticipations, the very objects, by which these views and feelings are impressed, themselves claim part of our hearts, and bind us by strong ties to the world, of which they teach us the vanity:—And this also is a beneficent provision. We cannot bear that heaven should be fully un-

veiled to us, while we remain denizens of earth. Such a vision would totally unfit us for our present station, and our present duties. An incident, mentioned by the eloquent author I have lately quoted more than once, will illustrate this. "I recollect that, on my return to France, in a vessel which had been on a voyage to India, as soon as the sailors had perfectly distinguished the land of their native country, they became, in a great measure, incapable of attending to the business of the ship. Some looked at it wistfully, without the power of minding any other object; others dressed themselves in their best clothes, as if they had been going that moment to disembark; some talked to themselves, and others wept. As we approached, the disorder of their mind increased. As they had been absent several years, there was no end to their admiration of the verdure of the hills, of the foliage of the trees, and even of the rocks which skirted the shore, covered over with sea weeds and mosses; as if all these objects had been perfectly new to them. The church-spires of the villages where they were born, which they distinguished at a distance up the country, and which they named, one after another, filled them with transports of delight. But when the vessel entered the port, and when they saw on the quays their friends, their fathers, their mothers, their wives, and their children, stretching out their arms to them with tears of joy, and calling them by their names, it was no longer possible to retain a single man on board; they all sprang ashore, and it became necessary, according to the custom of the port, to employ another set of mariners to bring the vessel to her moorings."*

There is an appearance of some high colouring in this picture; but it serves well to illustrate the view I am considering. There cannot be a doubt, that, were it not for the natural obtuseness of our mental vision in contemplating spiritual things, and the difficulty of realizing them to our understanding and our affections, the

* Studies of Nature, vol. ii. p. 289.

truths revealed to us in Scripture would make so deep an impression on our hearts, as to unfit us for the ordinary business of life. The world, with all its duties and all its ties, would appear "weary, stale, and unprofitable;" its affairs would come to a stand, and irrepressible longings to join the blessed throng, among whom some of the most fondly and deeply cherished friends of our hearts are mingled, would occupy the place of all sublunary things. If this world was to remain a place of discipline and of duty, it was necessary that heaven should continue veiled in the dim obscurity of distant and misty perspective, and that the spiritual should only be seen by reflection, as it were, from the material world.

FOURTEENTH WEEK—SUNDAY.

DAY OF PENTECOST.—ONE LANGUAGE.

The world had existed upwards of two thousand years, before the perverseness of the human race provoked the Creator to introduce the confusion of tongues, which was not only the means of scattering men of the same city, but probably, also, caused the disruption of the dearest family ties, and rendered parents and brethren aliens from each other. Century after century elapsed, and the idolatrous families, in their varied tongues, pursued their devious systems of folly in remote regions; and to them it might seem as if God took no account of the condition of his creatures. But with one people was the knowledge of the true God preserved, and in their language were those lively oracles written, which shall convey to man a view of the Divine character and requirements, even till time shall be no more.

Two thousand years again fleeted away after the memorable dispersion of Babel, when at last "The Promised" and "The Sent," fulfilled the burden of a thousand prophecies, and he who had walked in the midst of the furnace on the plain of Dura, manifested himself in mortal mould. While he tabernacled in the world, and exemplified the perfection of which man, when guided by the Divine Spirit, is capable, he had sent out seventy, endued with many miraculous gifts, so that themselves were filled with wonder, and rejoiced that even the evil spirits were subject to them. But still they were acquainted with only one tongue,—a vitiated dialect of the Hebrew, so that, whatever were their spiritual gifts, there was an obstacle which they encountered, in the very outset, to the fulfilment of their Master's parting command, to preach the gospel to every creature, and to teach all nations. Here then, when the judgment of Babel, which

resigned men to the idolatry they chose, by the loss of the language in which alone God was spoken of and preached, seemed about to be taken off, and all nations were to be invited to unite in believing the Gospel, that judgment, in its practical effect, presented a difficulty which mere human study might not surmount. "But," as Dr Lightfoot remarks, "one dividing of tongues was the casting off of the heathen, and another dividing of tongues restored the knowledge of God to the nations." Christ sends not his messengers a warfare at their own charges; he passed over the tedious process of study on their behalf, and fulfilled to them his word, "greater works than these shall ye do." Having passed himself from them and entered into the heavens, there to remain till the restitution of all things, he sent them the Comforter whom he had promised. "They were filled with the Holy Ghost, and began to speak with other tongues, as the spirit gave them utterance."

By this means were signs and wonders wrought, the holy name of the Redeemer exalted, the Gospel preached to men of divers languages, and thousands added to the church. But again this gift is withdrawn. It has appeared to give us a hint, on which our minds found a hope of what may be the Divine purpose in reference to the world hereafter, and an exhibition of the power by which present obstacles shall be set aside. It is the opinion of Archbishop Tillotson, that if the conversion of the heathen "were now sincerely and vigorously set about by men of honest mind, God would extraordinarily countenance such an attempt with all fitting assistance, as he did the first publication of the Gospel." If this infers an expectation of miraculous interference, we know not how far it may be consistent with the mysterious decrees of heaven. The nature of one of the difficulties the poor missionary knows right well, as he consumes life with the tardy operation of translating with his interpreter by his side, and announces to the watching Christians in Europe, how he has achieved the

gospel by John, or added to it a selection from some other gospel, or from the book of Psalms. But the degree of sincerity, or vigour, or concord required, before we become fitted to receive such aid as Tillotson hints at, we do not know; nor do we know that a departure from the ordinary means of grace will, under any circumstances, be necessary. Were we to venture a conjecture, we would say it is *concord* which is lacking in this weighty affair. We do not observe, with sufficient depth of conviction, the promise to those who are "*agreed* as touching what they shall ask." We do not mark the manner and times when "the kingdom of heaven has been taken by violence," and the Hearer of prayer has been, as it were, constrained,—but willingly constrained,—to bestow immediate and distinct answers.

When the gift of tongues was bestowed, the disciples were all, *with one accord*, in one place. There was no strife about which should be greatest; none of those divisions which occasionally existed during the time the Lord sojourned amongst them. They had obtained a partial bestowment of the Holy Spirit, and had learned to pray more, and consequently to love each other more. *They* were thus prepared to receive the full effusion of the Holy Ghost. And so must *we* be prepared. The solitary efforts of our various churches are enfeebled, not by their solitude, so much as by the absence of the uniting love, which shall bring down the accomplishment of the promises that all long for. That glorious day will teach men to cease from Paul and Apollos, and to feel that Christ is not divided. "Then shall the heart of the rash understand knowledge, and the tongue of the stammerers shall be ready to speak plainly." Then shall Zion be a quiet habitation, a tabernacle that shall not be taken down. But there the glorious Lord will be unto us a place of broad rivers and streams. The Lord will then be our judge, the Lord our lawgiver, the Lord our king; He will save us.

Of all modern efforts to overcome the difficulty pre-

sented by diversity of language, the Bible Society is that which has accomplished the most, and encourages the hope, that the Head of the Church will bless the endeavours of human industry and ingenuity. And since the Reformation, which broke down the wall,—the dead, blank wall, without a loop-hole,—which Popery had erected between the Scriptures and those for whom they were written, no scheme has been found so well calculated to shed the light of truth into all regions. The poor dispersed of Israel have now, by the zeal of that Society, the history of the Messiah presented to them in their ancient Hebrew. And the islands afar off, whose tongues till lately were reduced to no order, are taught to sing his praise. Blessed be his name for this day of small things, and blessed be they whose hearts he hath inclined to unite in this work! But still, is he not suffering our puny efforts for a time, to come forth upon us with the glorious contrast of his finished work? Will he not presently accomplish in his strength what his people have essayed in their weakness? And when, again, he baptizes the nations with the Holy Ghost as with fire, will he not take away the unknown tongue? And shall not utterance be given to all, the curse of Babel be removed, and Jew and Gentile, bond and free, glorify his name together? Then at last shall not men of all nations speak his praises in everlasting songs, and their ears rejoice to hear that which was committed only to the ear of John in his vision in the Isle of Patmos,—the united voice of every creature exclaiming, "Blessing, honour, glory, and power, be unto Him that sitteth upon the throne, and to the Lamb for ever and ever?"

Their voice and language shall be one,
Before the throne of God,
And no *confusion* shall be known,
In that divine abode.

M. G. L. D.

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